Review of Chinook Salmon Escapements in the Nechako River, British Columbia

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ABSTRACT

Jaremovic, L. and D. Rowland. 1988. Review of chinook salmon escapements in the Nechako River, British Columbia. Can. MS Rep. Fish. Aquat. Sci. 1963: 135 p.

Chinook salmon (Oncorhynchus tshawytscha) escapements, their distribution on the spawning grounds and spawner characteristics for the period of record to 1986 are presented for the Nechako River, a large tributary of the Fraser River, British Columbia. The report compiles data collected by the Department of Fisheries and Oceans for stock management purposes as well as data that were collected to assess the effects of proposed changes in river flow regime on chinook salmon. The report consists of two parts; Part I provides detailed spawning survey methods and results for the period 1983 to 1986 and Part II summarizes the historical data on Nechako River chinook populations and compares these with the more recent studies.

The Nechako River has been regulated since 1952 by Alcan Aluminium Limited (Alcan). Fishery officer reports suggest that prior to regulation, maximum escapements ranged from 2000 to 5000 chinook annually. Reduced flows in the period 1953 to 1956 depressed chinook spawning populations and population estimates, when available, were low until the 1970's. Escapements have increased in recent years (maximum 2600 in 1978 and 2000 in 1980, 1985 and 1986) but are depressed in comparison to other upper Fraser River chinook stocks. The report provides sources for all escapement estimates and limitations in the precision and accuracy of estimates are discussed.

Chinook spawning areas in the Nechako River are documented over a number of years. These areas are characterized by spawning dunes, which are large gravel ridges perpendicular to the river flow. Available records and examination of historical aerial photography indicates that spawning areas have been relatively stable; the most extensively used areas are found in the upper Nechako River within 30 kilometres of Cheslatta Falls, the upstream limit of salmon migration. In addition to spawning distributions, available data on spawning habitat characteristics, particularly depth and velocity preferences of chinook spawners, are summarized.

Spawner biological characteristics obtained from carcass recovery programs are compiled and include analyses of age, length and sex composition and data on fecundity and egg retention in female chinook.

RÉSUMÉ

Jaremovic, L. et D. Rowland, 1988. Revue des remontées de saumon quinnat dans la riviére Nechako, Colombie-Britannique. Can. MS Rep. Fish. Aquat. Sci. 1963; 135 p.

Ce rapport présente les remontées de saumon quinnat (Oncorhynchus tshawytscha), la distribution des poissons dans les frayères et les caractéristiques des géniteurs de la rivière Nechako pour la période couverte par des relevés jusqu'en 1986. La Nechako est un important tributaire du Fraser, Colombie-Britannique. Le rapport présente la compilation de données recuellies par le ministère des Pêches et Océans à des fins de gestion des stocks ainsi que des données recueillies afin d'évaluer les effets sur le quinnat des changements qu'on se propose d'apporter au régime d'écoulement de la rivière. Le rapport a deux parties: la partie I explique en détails les méthodes employées pour les relevés de fraie ainsi que les résultats de 1983 à 1986, et la partie II donne un apercu des données historiques connues sur les populations de quinnat de la riviére Nechako et compare ces données avec des études récentes.

Le débit de la Nechako est contrôlé depuis 1952 par la Alcan Aluminium Limited (Alcan). Les rapports des agents de pêche semblent indiquer qu'avant le contrôle du débit, les remontées maximum variaient entre 2 000 et 5 000 quinnats par années. La réduction du début dans la période 1953-1956 a déprimé les populations de quinnats géniteurs, et les évaluations démographiques, lorsque disponibles, ont indiqué de faibles populations jusqu'aux années soixante-dix. Les remontées sont meilleures depuis quelques années (maximum 2 600 en 1978 et 2 000 en 1980, 1985, 1986), mais restent faibles en comparaison des remontées d'autres stocks de quinnat dans la partie amont du bassin du Fraser. Le rapport indique les sources de toutes les évaluations des remontées et fournit une analyse des limites de précision et d'exactitude de ces relevés.

Les frayères de quinnat dans la rivière Nechako sont étudiées depuis nombre d'années. Ce sont des secteurs caractérisés par la présence de grandes crêtes de gravier disposées perpendiculairement aux cours d'eau. Les données accumulées et l'examen des relevés aériens indiquent que les frayères sont demeurées assez stables; on trouve les secteurs les plus intensivement utilisés dans la partie amont de la Nechako, dans un rayon de 30 kilomètres de Cheslatta Falls, soit dans la limite amont de la migration du saumon. En plus de la distribution des géniteurs, le rapport offre un résumé des données disponibles sur les caractéristiques des frayères, notamment les préférences de profondeur et de vitesse du courant des quinnats géniteurs.

Les caractéristiques biologiques des géniteurs qui ont été obtenues à partir des programmes de récupération des carcasses sont compilées et présentées sous la forme d'analyses d'âge, de longueur, de la répartition par sexe et d'analyses de données de la fécondité et de la rétention d'oeufs ches le quinnat femelle.

INTRODUCTION

The Nechako River, a tributary of the Fraser River, supports a major chinook salmon population and serves as a migration route for Stuart River chinook. Having had greater than 3000 chinook spawners recorded in the historical escapement records, the Nechako River is classed as a major chinook producing stream (McDougall, 1987).

The Nechako River chinook are grouped with the early summer run adults that migrate through the lower Fraser River in June and July bound for the upper Fraser River and tributaries. They arrive in the Nechako River in August, and spawn in September. Spawning takes place from Cheslatta Falls downstream to Vanderhoof, a distance of about 140 kilometres.

Studies on Nechako River chinook have varied in intensity over the period of record and have often been related to the regulated status of the river. Alcan has operated a dam on the river since 1952 (Figure 1). Fishery Officer escapement estimates and general comments on fish distribution are available as early as 1925. These early records, however, have unknown accuracy due to limited river access and effort. More detailed studies are related to the initial assessment of the Kemano hydroelectric project (McLaren 1952, 1953) and proposed developments that would complete the diversion of water from the Nechako River. These include the Kemano II and Kemano Completion projects and were the impetus of much of the Department of Fisheries and Ocean's studies (DFO, 1979; Russell et al. 1983; DFO, 1984). Other studies were related to the Salmon Enhancement Program (SEP) (Fee and Sheng, 1978; Olmsted et al., 1980). In addition, Alcan conducted their own studies and produced an environmental impact statement on Kemano Completion (Alcan, 1984). Following Alcan's postponement of the Kemano Completion Project in 1984, DFO has continued to monitor Nechako River chinook salmon to assess their returns.

The purpose of this report is to provide a compendium of these data on Nechako chinook populations against which future monitoring results can be compared. Under the terms of the 1987 Nechako River Settlement Agreement between Alcan

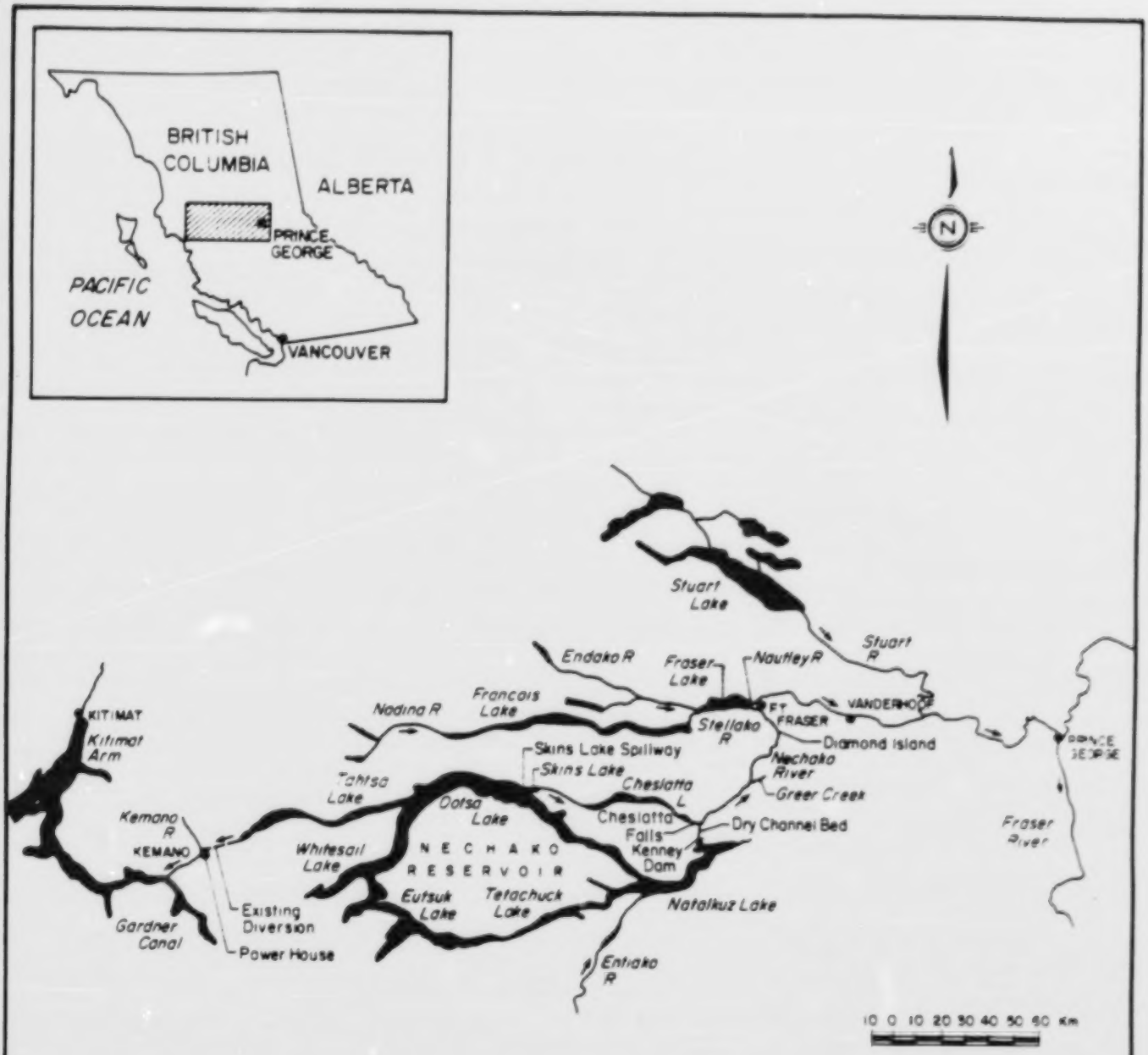


Figure 1

The Nechako reservoir, after the building of Kenney Dam, and the lower Nechako River and its main tributaries, the Nautley and Stuart Rivers. Reservoir waters flow westward for power generation at Kemano, or eastward, via Skins Lake Spillway and the Cheslatta Lake chain, to enter the existing bed of the Nechako River.

Aluminium Limited, the Federal Crown and the Provincial Crown, there is a long term committment to monitoring, applied research, and adoption of remedial measures to ensure the maintenance of chinook stocks in the Nechako River under a reduced flow regime.

Part I of this report documents the detailed methodology and results of spawning surveys from 1983 to 1986 conducted by DFO as these have not been previously published. Part II is summary compilation and review of all the available data on Nechako River chinook spawning populations. It includes a discussion of escapement estimates and trends, distribution of spawners, spawning habitat, and biological characteristics of the spawners.

PART I: SPAWNING SURVEYS 1983 TO 1986

Spawning escapement surveys were conducted by DFO from 1983 to 1986. These consisted of visual counts of spawners, distribution observations and carcass recovery programs. The intensity of the surveys varied, with the most intensive studies conducted in 1985 and 1986. A carcass recovery program was conducted in all years with the exception of 1983.

METHODS

SPAWNING ESCAPEMENT

The objectives of the spawning escapement programs were to document the abundance and distribution of spawning chinook between Cheslatta Falls and Vanderhoof (Figure 2). Mid-day helicopter flights were used for counting fish. In 1983 and 1984, counts by a Fishery Officer involved one and two helicopter overflights respectively. The 1983 count was conducted September 19, and the 1984 counts were conducted September 4 and 15.

Spawning surveys in 1985 and 1986 were more intensive. In 1985, helicopter surveys for counting chinook were conducted on four occasions: September 7, 11, 18 and 26. Generally, two observers and a navigator accompanied the pilot. The navigator announced river section boundaries (Figure 2) while the observers, equipped with polarized sun glasses to decrease glare from the river surface and increase visibility, made independent counts from the same side of the helicopter using hand counters. Numbers of migrating and spawning fish were recorded for each section on 1:50,000 topographic maps. The 16 river sections were consistent with sections defined in earlier studies (Russell et al., 1983). The arithmetic mean from the replicate counts was considered to be representative of the numbers of fish observed. In some cases, if one observer was inexperienced or momentarily distracted, the representative count was weighted toward the higher count. Flying, viewing and visibility conditions were recorded.

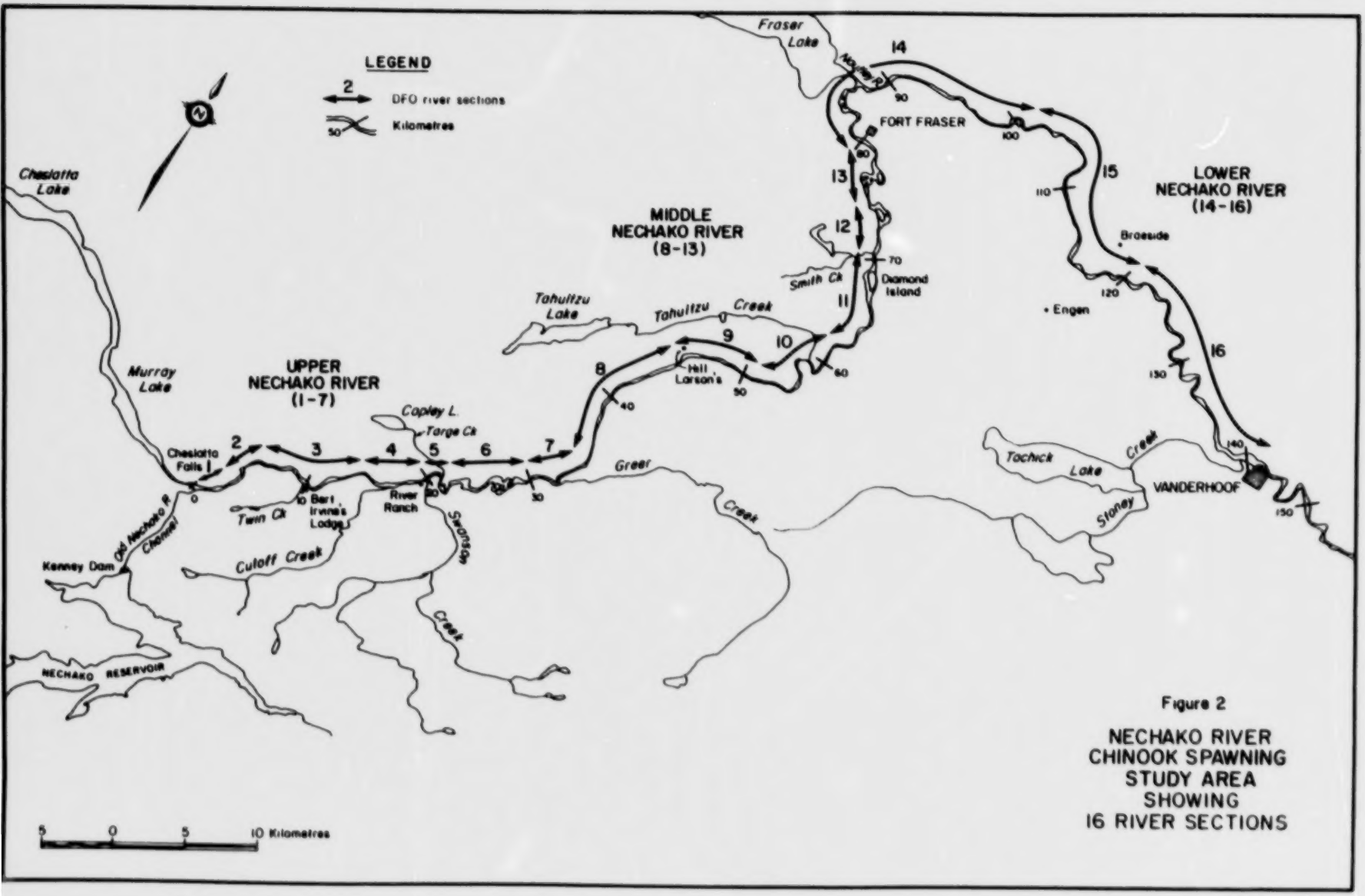


Figure 2

NECHAKO RIVER
CHINOOK SPAWNING
STUDY AREA
SHOWING
16 RIVER SECTIONS

In 1986, surveys were conducted September 3, 10, 16 and 23. Methods were similar to those described above for 1985. Replicate counts were, however, compared at frequent intervals and if a major discrepancy occurred, the section was recounted. In contrast with previous years, spawners were recorded for each kilometer or, when possible, within a kilometer. This allowed for more precise documentation of spawner distribution. These counts were also summed by river section to allow comparison with previous years' data.

For the purposes of this report, the river was subdivided into upper, middle and lower reaches (Figure 2). The upper reaches consist of sections 1-7 from Cheslatta Falls to Greer Creek, the mid reaches encompass sections 8-13 from Greer Creek to Fort Fraser and the lower reaches contain sections 14-16 from Fort Fraser to Vanderhoof.

REDD COUNTS

Redd counts were made only in 1986 during an aerial survey on October 10 when spawning was complete. In general, two criteria were used to identify redds; the presence of freshly cleaned gravel and a distinct tailspill. The number of redds was recorded in the same manner as live spawner counts on 1:50,000 topographic maps.

CARCASS RECOVERY

Chinook carcasses were recovered during September 11-28, 1984, September 6-30, 1985, and September 12 - October 2, 1986. Fish were recovered between Cheslatta Falls and Vanderhoof, with efforts concentrated on spawning areas in the upper and lower reaches. Prior to 1984, only the upper area from Cheslatta Falls to the vicinity of Greer Creek was sampled since most (85-90%) of the spawning occurred there.

The carcass recovery was conducted by a Job Creation crew in 1984, by DFO permanent and term staff in 1985, and by members of a Job Development Program in 1986.

A jet-drive riverboat was used for recovery. For all carcasses recovered, the following information was recorded: date of recovery, location by river section (1985 and 1986), postorbital-hypural length (POHL), sex and egg retention (in females). In 1984, individual recovery dates were not recorded, and recovery locations were designated as above and below Greer Creek (noted as "Reach 3" and "Reach 16" in Appendix 6). Ten scales were taken from each specimen for age analysis and in 1984, dorsal fin rays were collected for ocean age analysis. In 1985, one egg count was done. A ripe female was captured and sacrificed and an average egg count from several sub-samples determined. This value was multiplied by the ratio of total to sub-sample egg volume to yield the total egg count. After sampling, all carcasses were cut in half to prevent re-sampling.

Scale and Fin Analysis

Analysis of scales for estimating years of freshwater and ocean residence was performed by Y. Yole at DFO's Fish Morphology Laboratory. Fin rays collected in 1984 were analyzed by D. Chilton at the Pacific Biological Station (PBS) Ageing Unit. Thin ray cross-sections were examined to determine years of ocean residence. The scale and fin ray age determinations were used to estimate the total fish age.

RESULTS

SPAWNING ESCAPEMENT

Annual chinook spawning counts in the upper, mid and lower reaches of the Nechako River are presented for each survey date and year (1983-1986) in Appendix 1. Detailed data by date and river section are given for 1984, 1985 and 1986 in Appendices 2, 3 and 4 respectively.

Based on the available counts, the annual escapement estimates ranged from 800 - 900 in 1983 to 2000 spawners in 1985 and 1986 (Table 1). It should be noted that the 1983 estimate was based on only one flight, conducted September 19. This survey occurred past the peak of chinook spawning according to the Fishery Officer although the number of carcasses counted was only about 10% of the total count. Consequently, the Fishery Officer expanded the actual count of 641 to 800-900 spawners. Alcan also conducted a partial survey in 1983 and noted that September 18 was the approximate peak of spawning (Farina, 1984). In 1984, the highest of the two counts (1287 chinook) was obtained September 13 and the escapement estimate was rounded to 1300 spawners.

In 1985 and 1986, peak counts were similar, 1680 and 1640 chinook respectively. The timing of peak spawning was, however, about a week earlier in 1985 compared with 1986 (maximum counts were obtained between September 7-11 and September 16-23 respectively). In 1985, the first survey was conducted on September 7 and 1293 spawners were already in the river. On September 11, the maximum count was obtained and numbers had dropped substantially by September 18.

In 1986, chinook were beginning to occupy the spawning grounds by September 3. By September 16, most of the fish were paired on the redds and peak spawning occurred around this date. The observed timing was consistent with the reports made by a SEP crew who, during the week of September 16, captured Nechako females for egg takes for a winter incubation study. These females were ripe or had spawned. By September 23, numbers of live spawners in the mid/lower reaches

Table 1. Annual chinook escapement estimates and percent distribution in the upper, mid and lower reaches of the Nechako River, 1983-1986.

Year	Peak count	Escapement estimate[a]	% Distribution[b]		
			Upper (1-7)	Middle (8-13)	Lower (14-16)
1983	641	800-900[c]	35	20	45
1984	1287	1300	27	13	60
1985	1680	2000	36	32	32
1986	1640	2000	44	21	35

[a] Escapement estimates based on peak counts (see text). These estimates are reported in the Fishery Officer's spawning annual reports. Actual counts for each date are shown in Appendix 1.

[b] Percent distribution based on a single count or peak count if multiple counts were made.

[c] Fishery Officer estimate from single count on September 19.

between Greer Creek and Vanderhoof decreased significantly. However, numbers in the upper Nechako River between Cheslatta Falls and Greer Creek were similar to the September 16 counts. In some upper spawning locations, fish counts were greater on September 23 than on September 16 suggesting that additional fish had arrived on these grounds. One observer did note that a school of chinook was migrating in the upper Nechako River on September 16. Spawning was virtually completed by the end of September or early October in both years.

In the Fishery Officer's annual spawning report for 1985, the escapement estimate given is 2000 chinook. This is an expansion of the peak count by about 20 percent and recognizes that the peak count is an underestimate of the population. It does not take into account chinook that spawned prior to or following the peak. Assuming that the peak count provides a population index, an escapement of 2000 is reported for 1986, since peak counts in 1985 and 1986 were similar.

An estimate of 2000 chinook in 1985 and 1986 was consistent with the 1980 escapement estimate which had a similar peak count, namely 1,640 chinook (Appendix 10). The 1980 estimate was derived from 8 aerial counts conducted by Envirocon Ltd. To estimate population size, a spawner abundance curve was plotted and the total spawner-days corrected for female residence time on the redds (Alcan, 1984). The population estimate they obtained (2023 fish) was about 1.23 times the peak count. An attempt to analyze the 1985 and 1986 data using this method was inconclusive; the number of surveys was limited, some data points were inaccurate due to incomplete surveys of the river or poor visibility, and both migrating and spawning fish were counted (only spawners on the redds should be included in the analysis). In addition, it was not known whether the residence time determined in 1980 would be appropriate in 1985 and 1986.

While serial spawner surveys conducted in 1985 and 1986 ensured that counts were made at or close to the peak spawning time, peak counts or slightly expanded estimates can at best provide a relative index of escapement and the true spawning population of the Nechako River remains unknown. There is evidence from other stream surveys that visual estimates are always underestimates of the

total population and that Nechako River chinook could be underestimated by as much as a factor of two (Healey, pers. comm.). The relationship between visual counts observed during a flight survey and the total escapement to the Nechako River has not been determined and could only be assessed by comparing visual counts with an independent method such as a full stream fence count or a mark/recapture program.

Chinook redds counted October 10, 1986 are presented by river section in Appendix 5, and are summarized for upper, mid and lower Nechako reaches in Table 2. The mean total count of 828 redds corresponds to an average of 1656 spawners, assuming that each redd represents a spawning pair. The spawner estimate using redd counts was similar to the peak spawning count of 1680 chinook (Tables 1 and 2). However, redds below Greer Creek and particularly those in the lower Nechako River below Nautley (sections 14-16) were extremely difficult to distinguish and therefore are likely underestimated. For the upper river only (above Greer Creek), the spawner estimate based on redd counts (930) was 1.28 times the peak live count (728). This is consistent with the observations that indicated late arriving spawners in the upper river. If this factor of 1.28 was used to adjust the peak live count of 1640 spawners, a total escapement estimate of about 2100 chinook would be suggested. The accuracy of redd counts needs to be assessed further.

SPAWNING DISTRIBUTION

Percent distribution of chinook spawners in the upper, mid and lower reaches of the Nechako River is shown for 1983-1986 in Table 1. These distributions are based on a single spawner count available for 1983 and on maximum counts for 1984-1986. During 1983-1986, 40-68% of the Nechako chinook population spawned above Nautley River confluence (sections 1-13) with 27-44% in the upper reaches above Greer Creek (sections 1-7). In 1983 and 1984, a larger percentage of chinook spawned in the lower river (45-60% in sections 14-16) than in 1985 and 1986 (32-35%) (Table 1).

Table 2. Chinook redd counts and percent distribution in the upper, mid and lower reaches of the Nechako River, October 10, 1986.

	Location and DFO Section Number						Total
	Upper Nechako			Mid Nechako		Lower Nechako	
	1-2	3	4-7	8-10	11-13	14-16	
No. redds	82	236	147	85	96	182	828
Redd count (x2)[a]	164	472	294	170	192	364	1656
% Distribution		56			22	22	100

[a] Each redd is considered to represent a spawning pair.

The distribution of redds in 1986 indicated a larger percentage of spawners above Greer Creek than indicated by the peak spawning count (56% vs 44%, Tables 2 and 1 respectively). However, the uncertainty in redd counts makes the percent distribution of redds no more accurate a measure of total distribution than the distribution of spawners at peak count.

Percent distribution of spawners based on peak count by river section is shown for 1984-1986 in Figure 3 and Table 3. Detailed distribution of 1986 spawners i.e. within river sections is shown in Figure 4. The 1986 data are based on spawner and redd counts and supplemented by aerial photo interpretation. Major spawning areas in the Nechako River are characterized by gravel dunes and can often be identified on aerial photos. These areas as well as other spawning sites observed during field surveys but not identified on photos are shown in Figure 4.

In general, river section 3 has supported the largest percentage of spawners in all years (13.2-20.2%) in the upper river. As shown in Figure 4, a large number of sites occur throughout this section including the upper (km 7) and lower (km 9) spawning sites identified in 1974 studies (DFE, 1979). Spawners are also scattered in moderate numbers almost to Greer Creek (km 32) in section 7. Below Greer Creek, spawning areas are more dispersed. Virtually no spawning occurs in sections 7, 8 and 9 (from Greer Creek to km 51) with the exception of sites near Larson's (km 46-47). Scattered spawning occurs again from section 10 to section 12 (km 51-75) which includes the Diamond Island area. Limited spawning occurs in section 13 and much of the river in the 50 km below Nautley River (sections 14-16) is not utilized. Spawning in the lower Nechako River occurs at discrete sites including in the vicinity of km 91 and km 94, at the Braeside/Engen site (km 114-116) and in the vicinity of Vanderhoof (km 137-140).

CARCASS RECOVERY

The total carcasses recovered in 1984, 1985 and 1986 were 178, 184 and 205 respectively. Detailed information on each fish is presented in Appendix 6 as

Figure 3 Percent Distribution of Chinook Spawners in the Nechako River by Section, 1984-1986

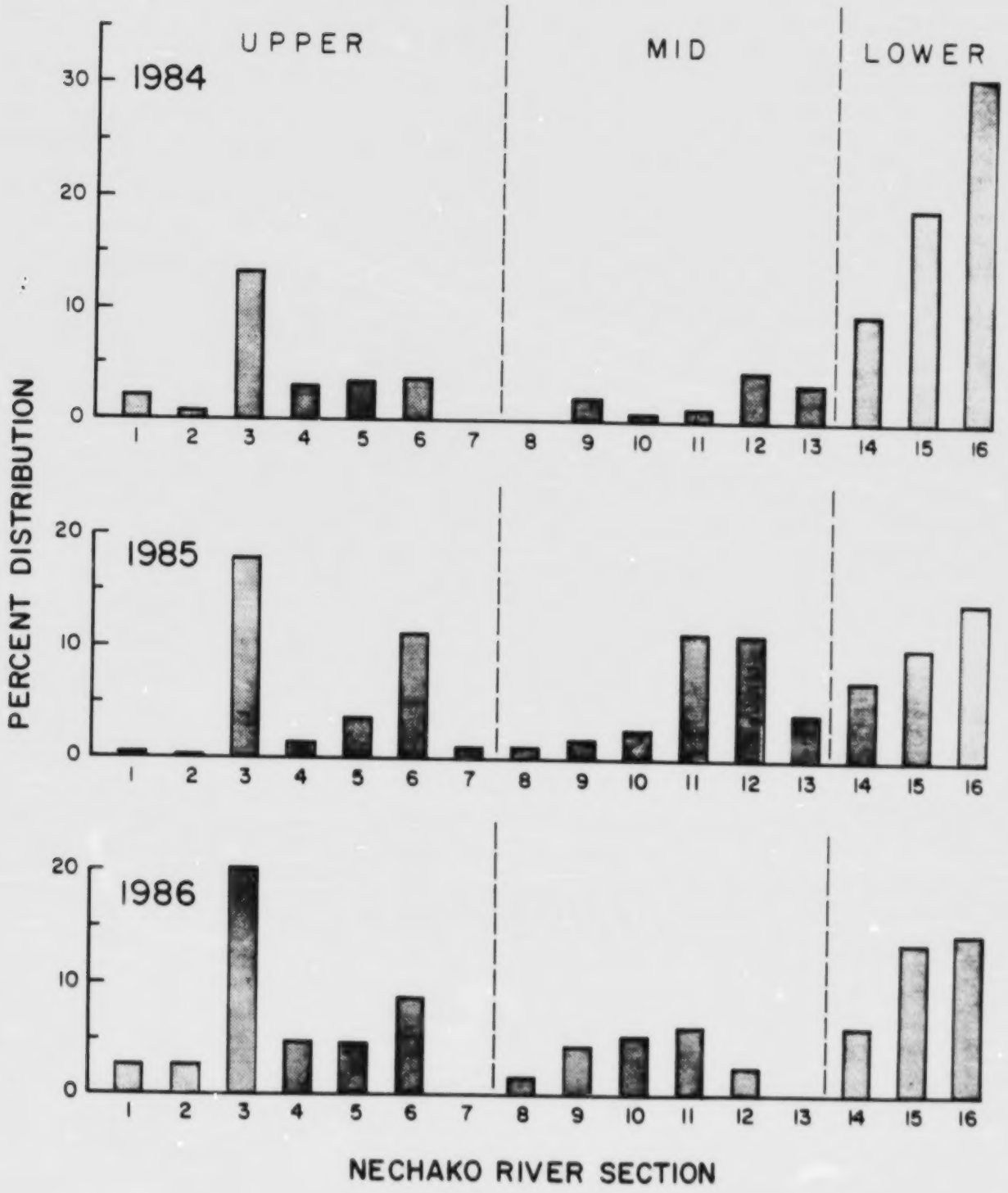
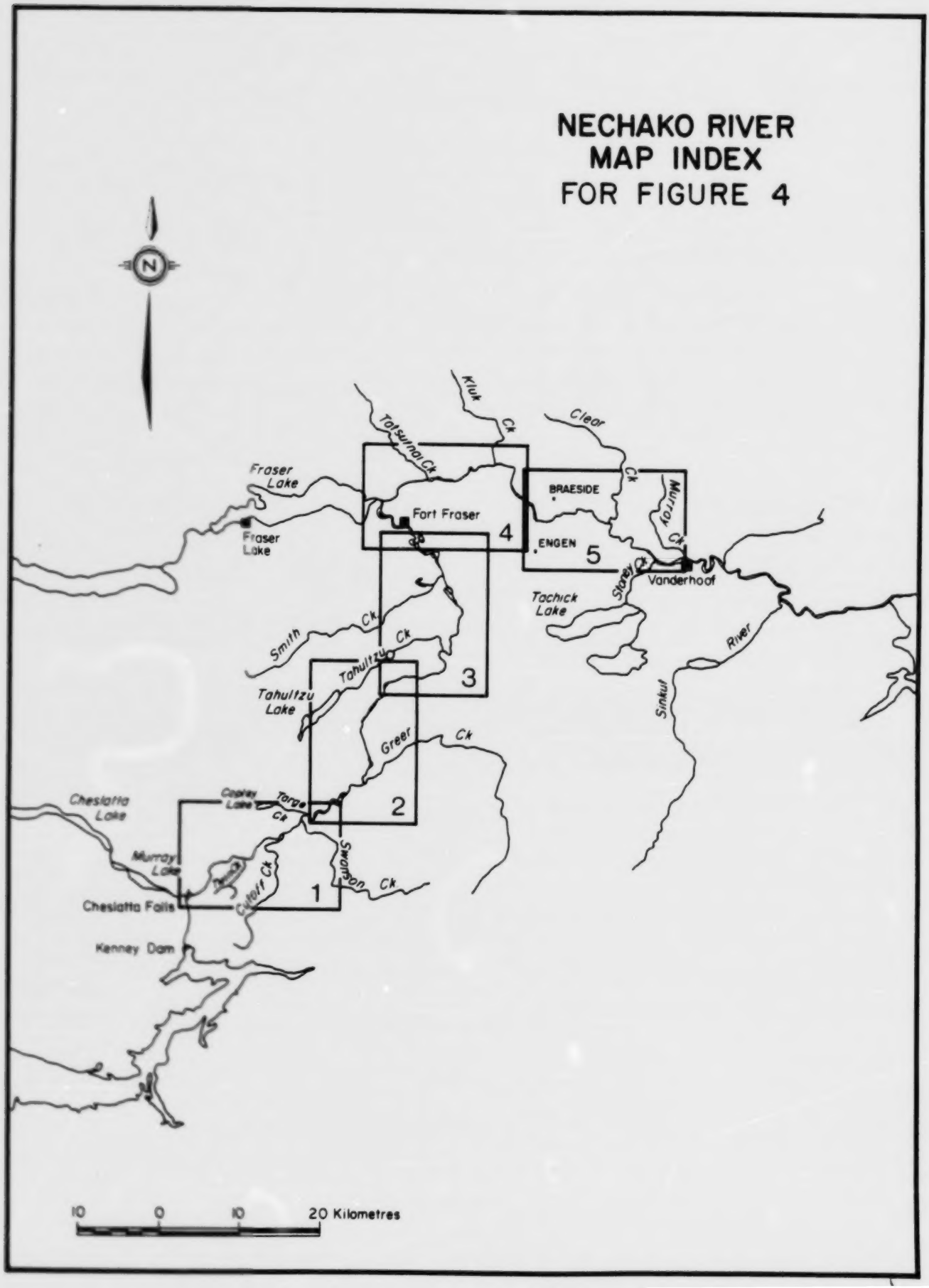


Table 3. Percent distribution of chinook spawners in the Nechako River by section, 1984-1986.[a]

Section		Year 1984	1985	1986
1	Cheslatta Falls	2.3	0.5	2.7
2		0.8	0.3	2.9
3	Bert Irvine's	13.2	17.8	20.2
4		3.1	1.5	4.8
5	Swanson Cr.	3.5	3.6	4.8
6		3.9	11.2	8.8
7	Greer Cr.	0	1.1	0.1
8		0	1.1	1.8
9	Larson's	2.3	1.8	4.6
10		0.9	2.8	5.5
11	Diamond Island	1.4	11.3	6.4
12		4.7	11.1	2.6
13	Fort Fraser	3.7	4.2	0.1
14	Nautley R.	9.7	7.2	6.3
15	Braeside	19.4	10.2	13.8
16	Vanderhoof	31.1	14.3	14.6
Total		100	100	100
Peak count		1287	1680	1640

[a] Based on peak count for each year, see Appendices 2-4.


NECHAKO RIVER
MAP INDEX
FOR FIGURE 4
N
Klwk Ck
Clear Ck
Murray Ck
Tatsuyna Ck
Fraser Lake
Fort Fraser
BRAESIDE
ENGEN
Vanderhoof
Stuart
Tachick Lake
Smith Ck
Tahultzu Ck
Tahultzu Lake
Greer Ck
Sinkut River
Chesiatta Lake
Torpy Ck
Murray Lake
Cutoff Ck
Swanson Ck
Chesiatta Falls
Kenney Dam
1
2
3
4
5
10 0 10 20 Kilometres

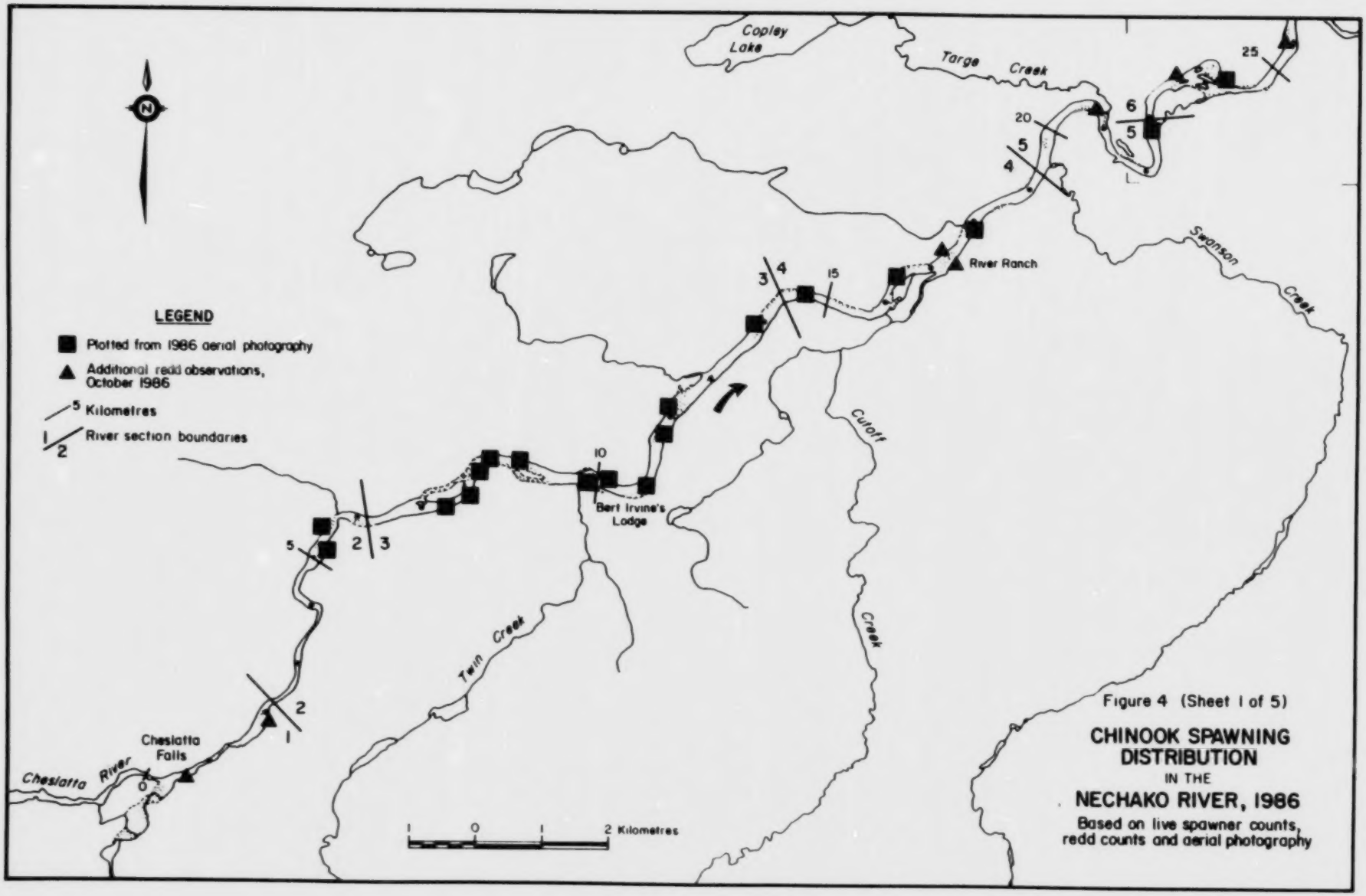


Figure 4 (Sheet 1 of 5)

CHINOOK SPAWNING DISTRIBUTION
IN THE
NECHAKO RIVER, 1986
Based on live spawner counts, redd counts and aerial photography

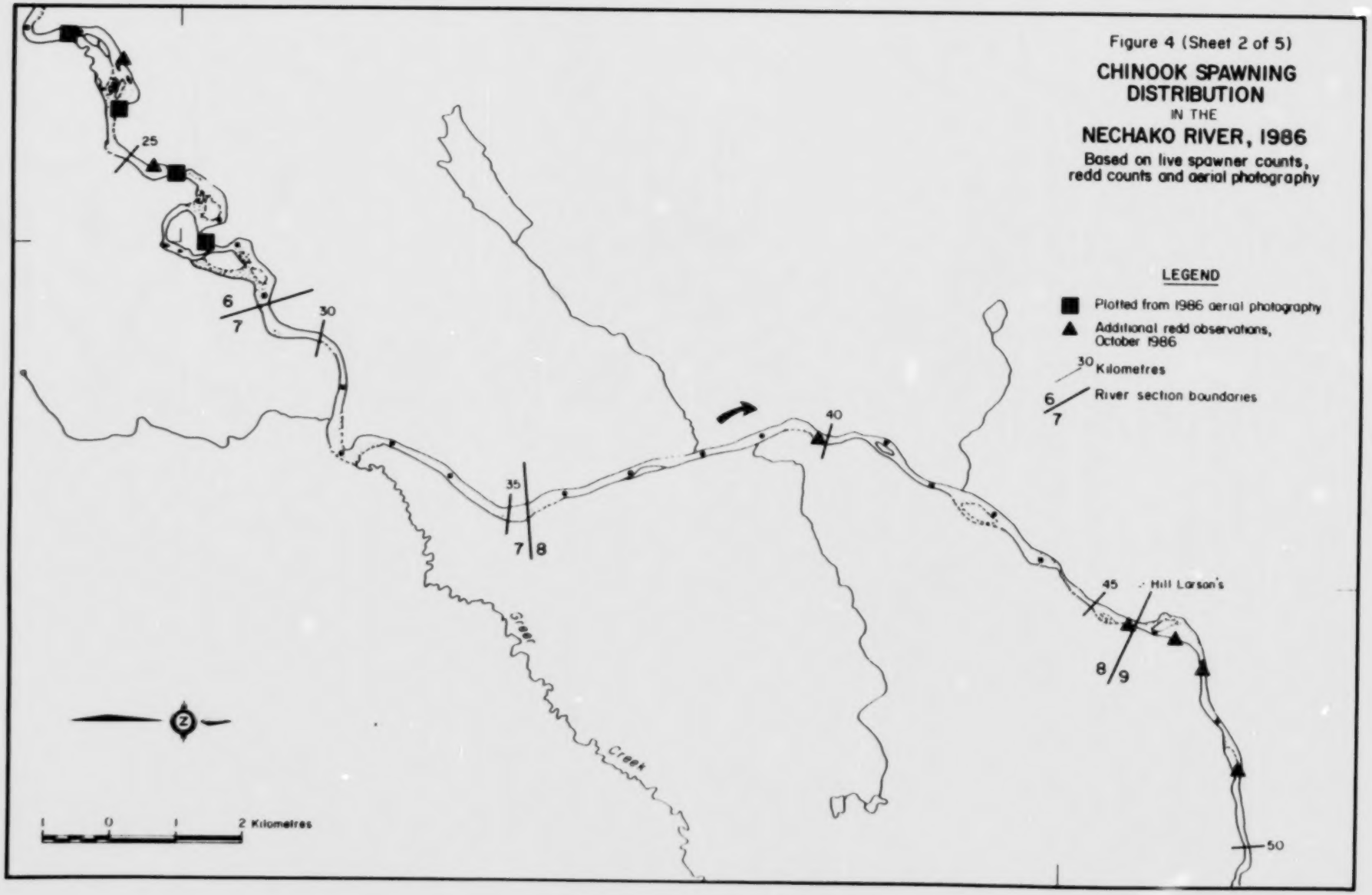


Figure 4 (Sheet 2 of 5)
CHINOOK SPAWNING DISTRIBUTION
IN THE
NECHAKO RIVER, 1986
Based on live spawner counts, redd counts and aerial photography
LEGEND
Plotted from 1986 aerial photography
Additional redd observations, October 1986
30 Kilometres
6/7 River section boundaries
25
6/7
30
35
7/8
40
45
Hill Larson's
8/9
50
Creek
N
1 0 1 2 Kilometres

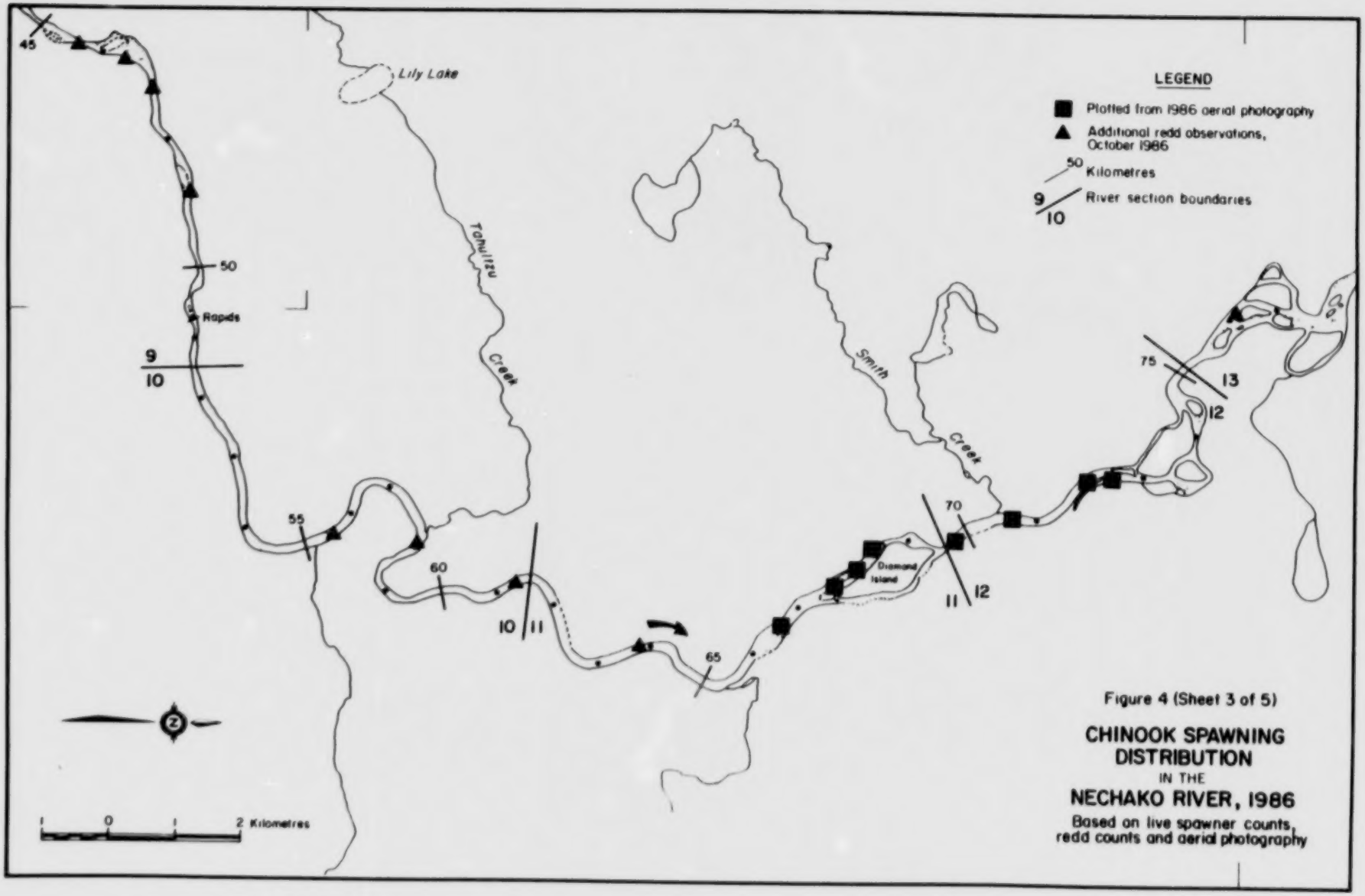


Figure 4 (Sheet 3 of 5)

CHINOOK SPAWNING DISTRIBUTION
IN THE
NECHAKO RIVER, 1986
Based on live spawner counts, redd counts and aerial photography

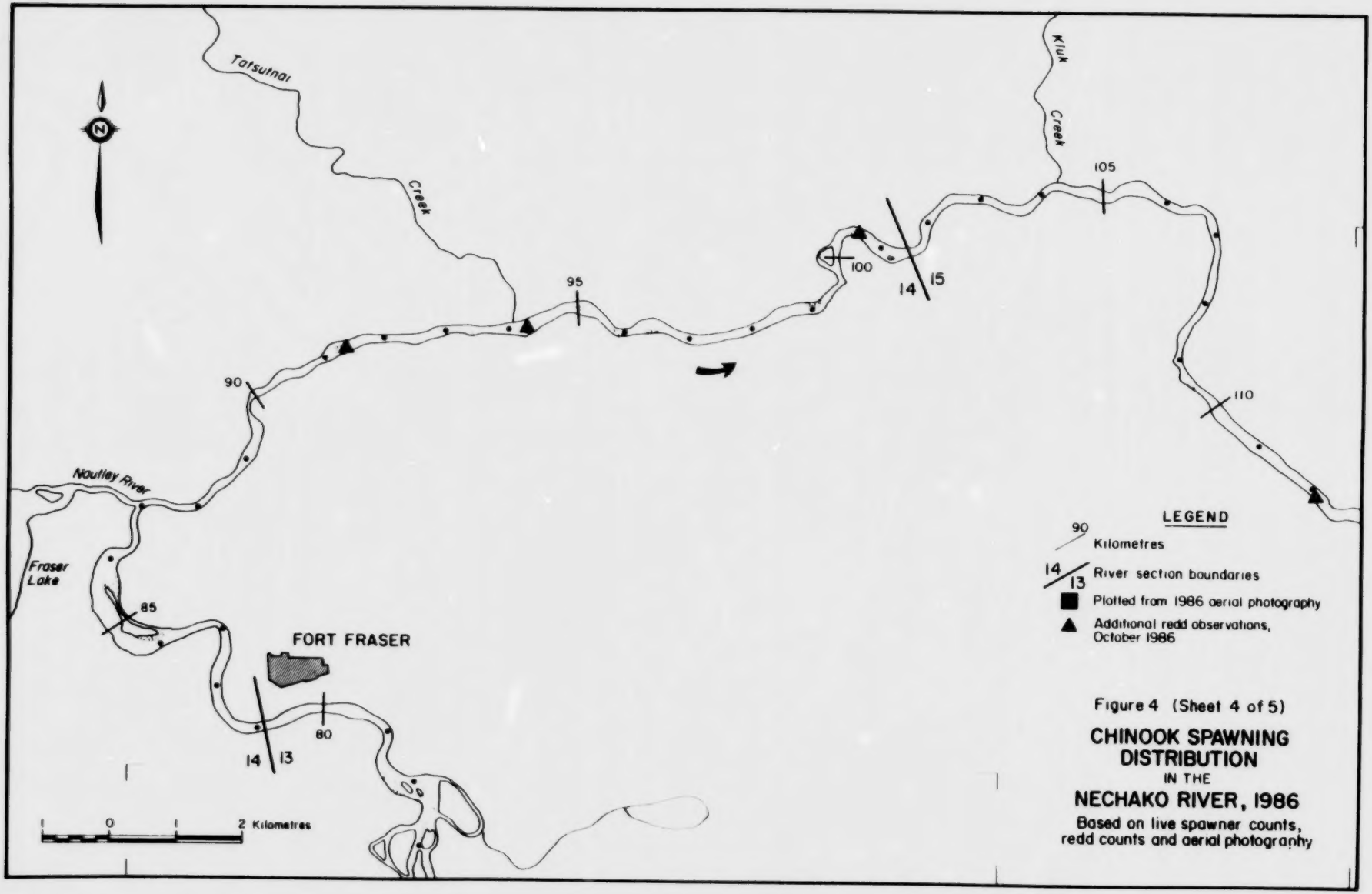


Figure 4 (Sheet 4 of 5)

CHINOOK SPAWNING DISTRIBUTION IN THE NECHAKO RIVER, 1986

Based on live spawner counts, redd counts and aerial photography

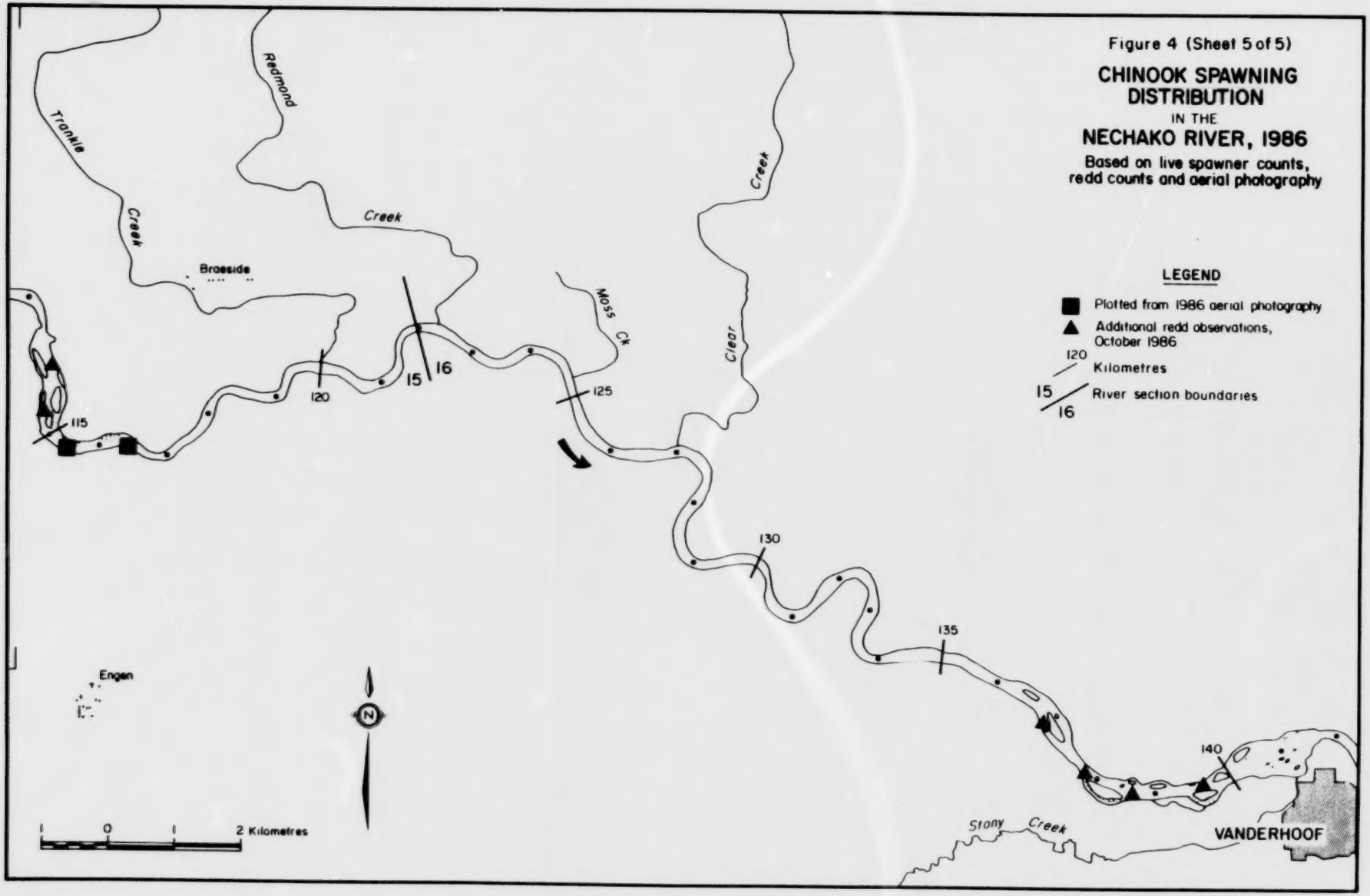


Figure 4 (Sheet 5 of 5)
CHINOOK SPAWNING DISTRIBUTION
IN THE
NECHAKO RIVER, 1986
Based on live spawner counts, redd counts and aerial photography
LEGEND
Plotted from 1986 aerial photography
Additional redd observations, October 1986
120 Kilometres
15/16 River section boundaries
Tronkle Creek
Redmond Creek
Creek
Braeside
Moss Ck
Clear Creek
115
120
15
16
125
130
135
140
Engen
N
0
2 Kilometres
Stony Creek
VANDERHOOF

well as data on carcasses recovered in 1980, 1981 and 1982 (discussed in Part II). Results on mean postorbital-hypural length (POHL), age, sex composition, fecundity and egg retention are presented below.

Length

Mean POHL for males and females in the upper (sections 1-7), mid/lower (sections 8-16) and all reaches (sections 1-16) are shown in Table 4. Size data for mid reaches (sections 8-13) were not isolated due to small sample sizes.

Mean lengths for all fish averaged 67.4 cm in 1984, 72.1 cm in 1985 and 71.3 cm in 1986. Mean length for 1984 was significantly ($p<0.05$) smaller compared to mean lengths for 1985 and 1986, which had similar mean fish sizes. This variation between years is shown clearly in the annual length frequency distribution curves (Figure 5). The smaller mean lengths documented in 1984 as compared to 1985 and 1986 are likely a result of the dominance of the younger fish in 1984. Age 4 and younger fish constituted 64.6% of the 1984 recoveries but only 29.6% and 30.9% of the 1985 and 1986 recoveries (Table 5).

Females were smaller than males in all years sampled with the size difference between sexes significant ($p<0.05$) only in 1986. Overall mean fish sizes showed no significant difference ($p<0.05$) between the upper (sections 1-7) and mid/lower (sections 8-16) reaches in all years.

Age Composition

Age composition of chinook adults, as determined from scale analysis, is summarized in Table 5. Four and five year olds with one full year in freshwater dominated the spawning population in all years (93-99% of the aged fish) with age 4_2 dominant in 1984 and age 5_2 dominant in 1985 and 1986:

Table 4. Mean postorbital-hypural length of chinook spawners by sex and reaches, Nechako River, 1984-1986 (n = sample size).

Year	Reaches (sections)	Length (cm) ± 1 S.E.[a] Males (n)	Females (n)	Total (n)
1984	Upper (1-7)	67.4 ± 2.2 (8)	65.3 ± 2.0 (12)	66.1 ± 1.5 (20)
	Mid/Lower (8-16)	68.6 ± 1.2 (73)	66.8 ± 0.8 (85)	67.6 ± 0.7 (158)
	All (1-16)	68.1 ± 1.1 (81)	66.9 ± 0.7 (97)	67.4 ± 0.6 (178)
1985	Upper (1-7)	70.7 ± 1.4 (33)	71.3 ± 0.7 (58)	71.1 ± 0.7 (91)
	Mid/Lower (8-16)	75.8 ± 1.6 (30)	71.9 ± 0.8 (63)	73.2 ± 0.8 (93)
	All (1-16)	73.1 ± 1.1 (63)	71.6 ± 0.5 (121)	72.1 ± 0.5 (184)
1986	Upper (1-7)	74.8 ± 0.9 (61)	67.8 ± 0.7 (85)	70.7 ± 0.6 (146)
	Mid/Lower (8-16)	74.4 ± 1.1 (40)	68.7 ± 1.1 (19)	72.6 ± 0.9 (59)
	All (1-16)	74.7 ± 0.7 (101)	68.0 ± 0.6 (104)	71.3 ± 0.5 (205)

[a] S.E. standard error

Figure 5 Length Frequency Distribution of Chinook Spawners in the Nechako River, 1984-1986

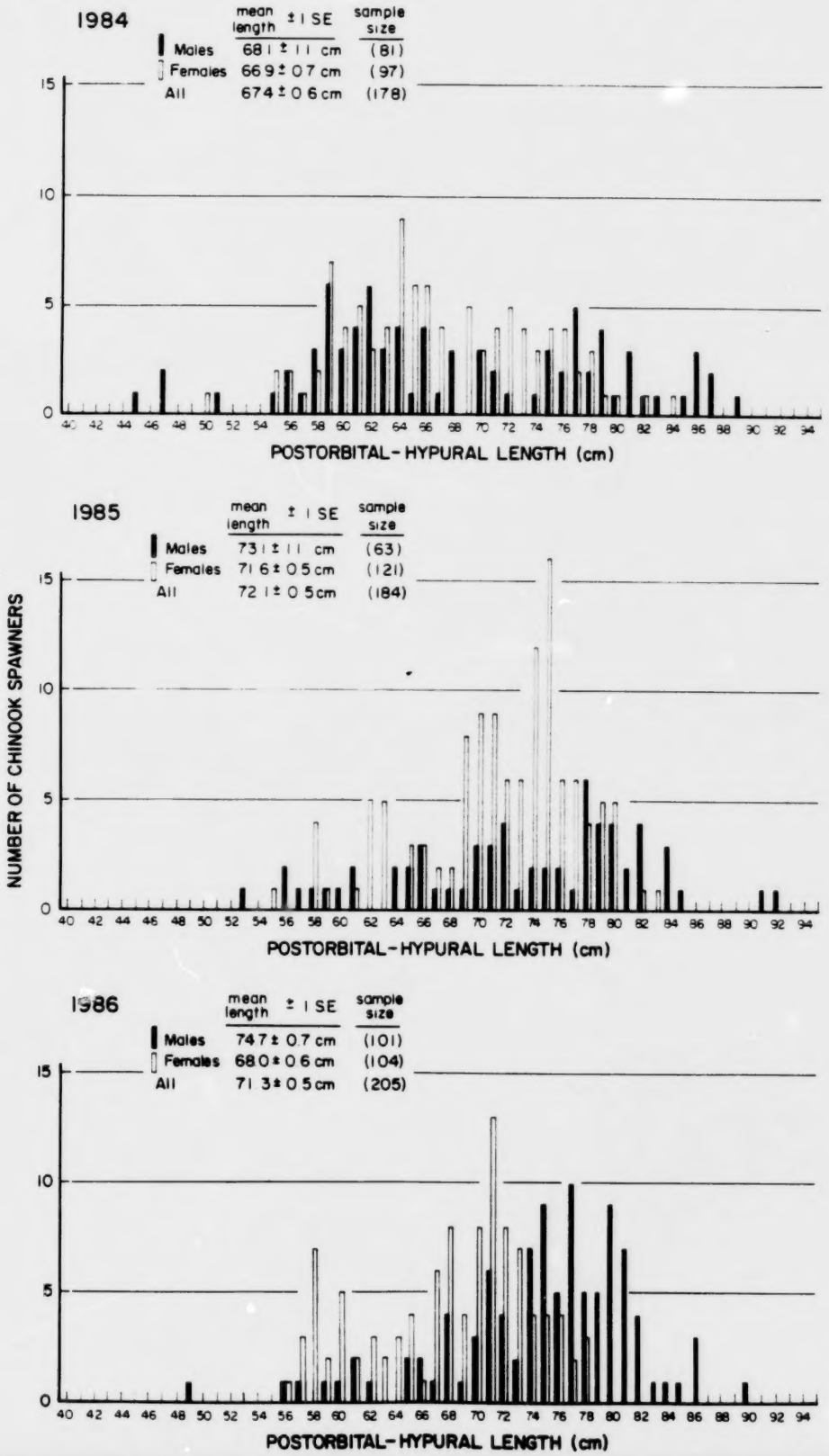

1984
mean length ± 1 SE
sample size
Males 68 1 ± 1 1 cm (81)
Females 66 9 ± 0 7 cm (97)
All 67 4 ± 0 6 cm (178)
1985
Males 73 1 ± 1 1 cm (63)
Females 71 6 ± 0 5 cm (121)
All 72 1 ± 0 5 cm (184)
1986
Males 74 7 ± 0 7 cm (101)
Females 68 0 ± 0 6 cm (104)
All 71 3 ± 0 5 cm (205)
NUMBER OF CHINOOK SPAWNERS
POSTORBITAL-HYPURAL LENGTH (cm)

Table 5. Percent age composition of chinook spawners by reaches (top) and sex (bottom), Nechako River, 1984-1986.[a]

Year	Reaches	% Age Composition by Reaches								Number of Readable Scales
		3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2	
1984	Upper	-	-	13.3	46.7	-	40.0	-	-	15
	Mid/Lower	-	2.3	-	62.9	-	31.1	-	3.7	132
	All	-	2.0	1.4	61.2	-	32.0	-	3.4	147
1985	Upper	-	-	-	34.8	-	65.2	-	-	69
	Mid/Lower	-	-	1.4	23.3	-	75.3	-	-	73
	All	-	-	0.7	28.9	-	70.4	-	-	142
1986	Upper	-	1.0	-	29.3	-	63.6	-	6.1	99
	Mid/Lower	-	2.5	-	30.0	-	67.5	-	-	40
	All	-	1.4	-	29.5	-	64.8	-	4.3	139

Year	Sex	% Age Composition by Sex								Number of Readable Scales
		3_1	3_2	4_1	4_2	5_1	5_2	6_1	6_2	
1984	Male	-	4.3	1.5	55.1	-	34.8	-	4.3	69
	Female	-	-	1.3	66.7	-	29.5	-	2.5	78
1985	Male	-	-	-	40.4	-	59.6	-	-	47
	Female	-	-	1.0	23.2	-	75.8	-	-	95
1986	Male	-	3.1	-	20.0	-	70.8	-	6.1	65
	Female	-	-	-	37.8	-	59.5	-	2.7	74

[a] Determined using scale analysis.

Year	Age 4_2	Age 5_2
1984	61.2%	32.0%
1985	28.9%	70.4%
1986	29.5%	64.8%

The upper reaches had generally similar age composition as the mid/lower reaches, with a somewhat younger age structure observed in 1985 in the upper reaches. No obvious age difference was noted between males and females, although compared to females, males were somewhat younger in 1985 and older in 1986. The percentage of aged adults that spent one full year in freshwater prior to seaward migration was 98.6% in 1984, 99.3% in 1985 and 100% in 1986 (Table 5).

A comparison of the scale and fin ray analyses carried out in 1984 showed an overall older age composition as determined from fin rays (Table 6). With the fin ray method, age 5 and older fish constituted 50.9% of the total sample, largely due to a strong age 6_2 component (19.3%). In comparison, age 5 and older fish constituted only 35.4% of the total sample using the scale analysis. Of the 140 samples for which both readable scales and fin rays were available, 100 (71.4%) agreed in age, while 40 (28.6%) did not (Appendix 6). In 37 of the 40 cases of disagreement, the age estimates from fin rays were higher than age estimates from scales.

Sex Composition

Sex composition of the sampled carcasses (Table 5) showed a somewhat higher proportion of females in 1984 and 1985, and an even sex ratio in 1986:

Year	Sample size	% Males	% Females
1984	178	45.5	54.5
1985	184	34.2	65.8
1986	205	49.3	50.7

Table 6. Percent age composition of chinook spawners by reaches, as determined from fin ray analysis, Nechako River, 1984.

Reaches	% Age Composition by Reaches									Number of Readable Fins
	3_1	4_1	4_2	5_1	5_2	6_1	6_2	7_2	8_2	
Upper	-	11.1	27.8	-	44.4	-	11.1	5.6	-	18
Mid/Lower	1.3	-	49.0	-	25.5	-	20.3	2.6	1.3	153
All	1.2	1.2	46.8	-	27.5	-	19.3	2.9	1.2	171
All (scales)[a]	2.0	1.4	61.2	-	32.0	-	3.4	-	-	147

[a] From Table 5.

It should be noted that sex composition based on dead recovery may be different from that of the live chinook population due to differences in residence time between males and females.

Fecundity and egg retention

Only one unspawned chinook female was sampled for an egg count in 1985. The female had a postorbital-hypural length of 760 mm and contained 6800 eggs.

Mean egg retention was low ranging from 21 to 30 eggs per female for the three years sampled. Of a total 321 carcasses, 19 retained over 100 eggs (Appendix 6).

PART II: REVIEW OF HISTORICAL AND RECENT DATA ON CHINOOK SPAWNING POPULATIONS IN THE NECHAKO RIVER

This second part of the report reviews all available data on chinook spawners in the Nechako River. The escapements are described for the period preceding Kemano I, that is, prior to the construction of Kenney Dam, during reservoir filling and following river regulation through the Skins Lake Spillway. Since the water flows have influenced the escapement estimates, it is useful to begin with a summary of the Nechako River flow regime.

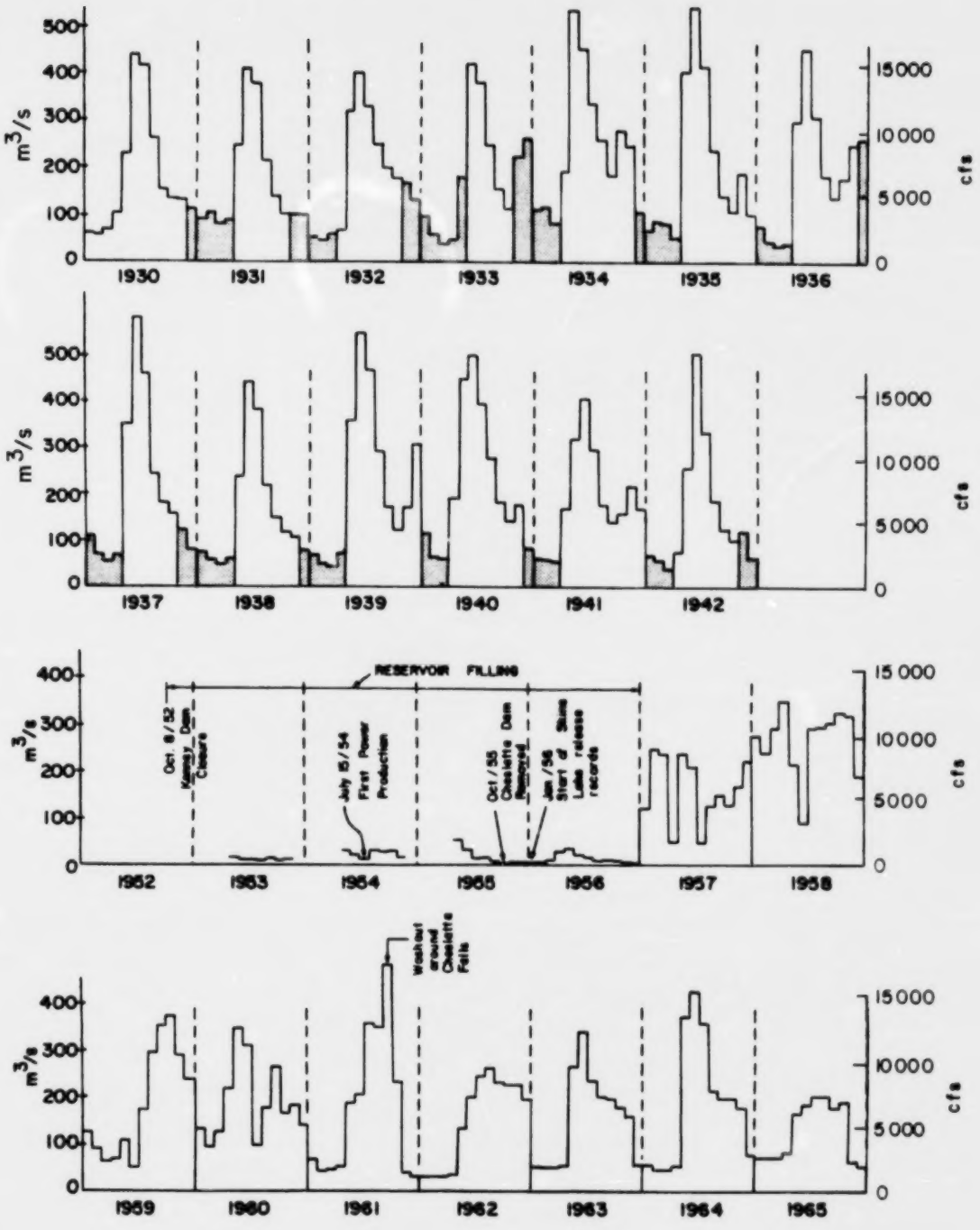
NECHAKO RIVER FLOW REGIME

The Nechako River flow regime from 1930 to the present is shown in Figure 6. The hydrographs from 1930 to 1942 are representative of the natural flow regime prior to the construction of Kenney Dam and those from 1952 to 1956 show the very low flows in the Nechako River during reservoir filling. Beginning in 1956, water was released by Alcan through the Skins Lake Spillway. The period from 1957 to 1978 shows highly variable flow. In the winter of 1979, flows were reduced to approximately 11.3 m^3/s (400 cfs) and DFO obtained a court injunction in 1980 which specified a minimum flow regime for the Nechako River. It specified 31.1 m^3/s or 1100 cfs for chinook spawning and incubation (September 1 - March 31) and 56.6 m^3/s or 2000 cfs for chinook rearing (April 1 - August 31). The injunction flows were in effect from 1980 to 1985.

Figure 7 and Appendix 7 show the mean September (i.e. spawning) flows from 1930 to 1986. The mean pre Kemano spawning flow (1930-1952) was 152.3 m^3/s (5377 cfs) ranging from 117 m^3/s (4132 cfs) to 206 m^3/s (7275 cfs). During reservoir filling, flows ranged from 8.1 to 28.1 m^3/s (286 to 992 cfs). Prior to the substantially lower flows beginning in 1978, the post Kemano spawning flows (1957-1977) were higher (averaging 200.9 m^3/s; 7095 cfs) than under the natural regime with a much larger variation in flow from year to year (27.8-483 m^3/s; 982-17057 cfs). Recent flows from 1978 to 1986 represent a reduction from

Figure 6 Nechako River Monthly Flows 1930 -1942 ; 1953 - 1986

(adapted from Hamilton, 1987)

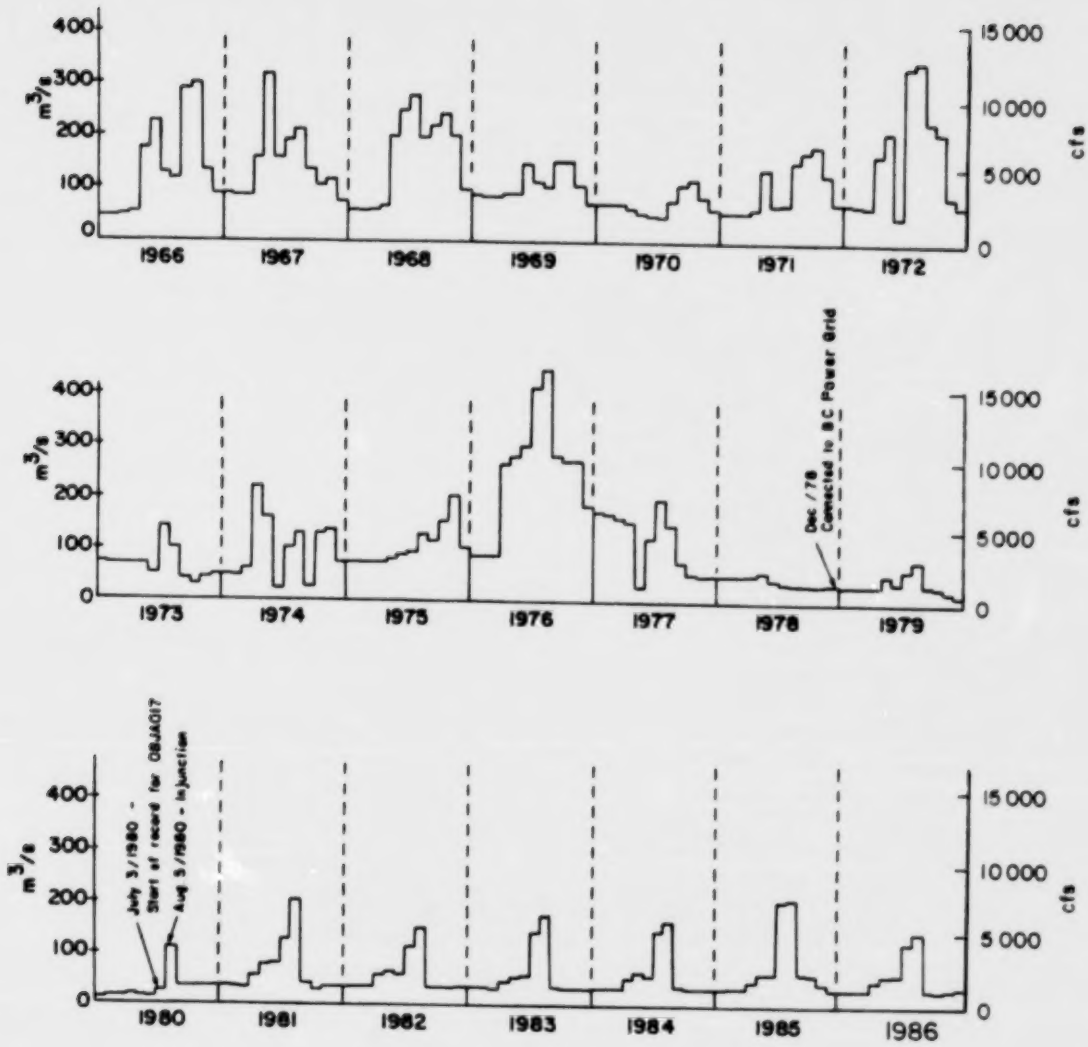


Data sources: 1930 - 1942 ☐ Fort Fraser (08JA001)

■ Ootsa (08JA002) + Tetachuk (08JA004)

1953 - 1956 Nechako at Vanderhoof (08JC001) minus Nautley (08JB003)

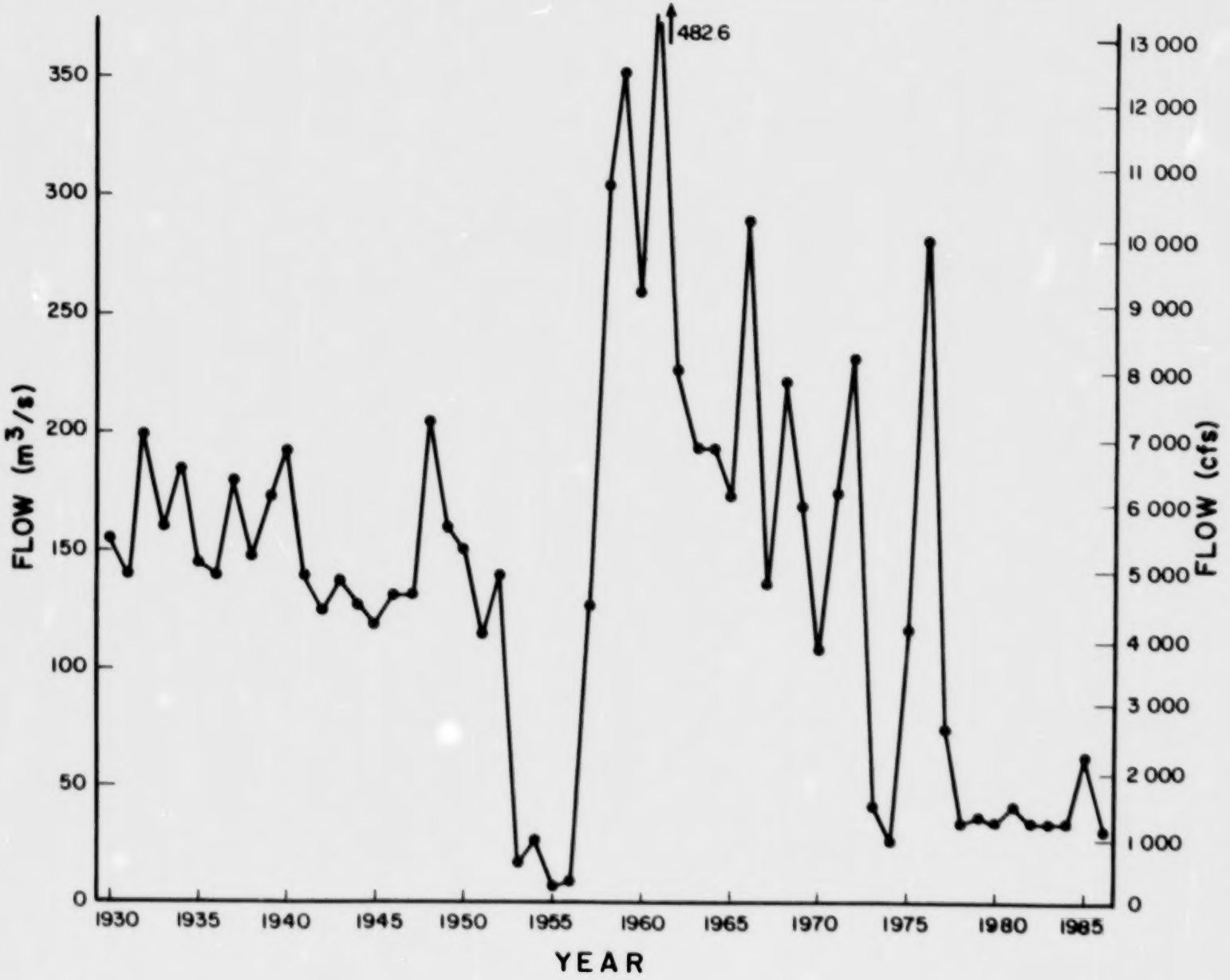
Figure 6 continued



Data sources: 1957 - 1981 Alcan 1984. Kemano Completion Hydroelectric Development Environmental Studies. Vol. 2 Physical and Hydrological Studies: baseline information, p. 627

1981 - 1986 Nechako River below Cheslatta Falls (08JA017)

Figure 7 Mean September Flows in the Nechako River, 1930-1986



pre Kemano flows of about 74%. Spawning flows averaged 36 m^3/s (1272 cfs) with the exception of 1985 when flows were 64.4 m^3/s (2274 cfs).

CHINOOK TIMING

Early Fishery Officer reports indicated that chinook usually arrived in the Nechako River in August. Based on more detailed investigations in 1949, 1950 and 1951, McLaren (1952) reported that chinook arrived in the upper river (Fort Fraser) in the latter part of August, and that peak spawning occurred about the middle of September and ended by October 15. This was generally the timing reported in the Fishery Officer reports following Kemano I, with peak spawning generally in the third week of September. Recent studies indicated peak spawning in the second or third week of September and completion by the beginning of October. For example, in 1985 the largest number of spawners was recorded from September 7 to 11 while in 1986 the maximum count occurred from September 16 to 23.

Since surveys generally begin at the start of spawning (i.e. the beginning of September), little information is available on the timing of arrival in the system except for incidental observations. Fee and Sheng (1978) reported that chinook first arrived at the Nautley confluence August 1, 1978 and at Bert Irvine's Lodge on August 12. Alcan (1984) first observed chinook in the upper Nechako on August 14 and August 20 in 1979 and 1980 respectively. In 1986, an adult chinook was observed in the upper Nechako River downstream of Bert Irvine's Lodge on August 11.

Although it is not possible to determine the precise timing of migration of the Nechako stock through the lower Fraser River without tagging data, it is believed that the Nechako chinook move through the lower Fraser in June and July (Harrison, pers. comm.). Nechako River chinook are grouped with the early summer chinook (before July 15) which are dominated by fish bound for the Upper Fraser River and tributaries above Lillooet. Nechako chinook are, however, one of the latest spawning stocks of chinook in the Upper Fraser River (Harrison, pers. comm.).

CHINOOK ESCAPEMENTS

Reported Nechako River chinook escapements for the period of record are shown in Table 7 and Figure 8. These are compiled mainly from Fishery Officer reports, but use estimates derived from more intensive surveys when available. These estimates are considered to be the best available and are part of the DFO escapement data base used for management purposes. More detailed data are presented in appendices 8 to 10.

PRE KEMANO I ESCAPEMENTS

Escapement records for the Nechako River extend from 1925 to the present in the "Annual reports of salmon stream and spawning grounds" (BC 16's) compiled by the Prince George fishery officer (Appendix 8). From 1925 to 1934, however, the chinook run is described only as light, medium or heavy with no quantitative definition of these categories. In 1934, the fishery officer began to assign a letter code that corresponded to an annual escapement range. While the fishery officer reports represent a complete record, the interpretation of escapement estimates is subject to error. The escapement estimates in many cases were based on partial surveys only, often relying on "trapper" reports to estimate numbers of chinook in the major spawning areas of the upper Nechako River. The early reports do not document the method of survey, the frequency of visits or the dates of observation, all factors that are necessary to provide a reliable population estimate or index that can be compared from year to year. In addition, the Nechako River flows were several times the magnitude of recent (1978 to present) spawning flows undoubtedly making accurate counts difficult if not impossible (McLaren, 1952; Coles, 1953). The analysis of trends in escapement in the Nechako River must recognize these limitations.

The maximum escapement recorded by the Fishery Officer during this time ranged between 2000 to 5000 chinook and the minimum 100 to 300. More detailed investigations were, however, conducted by DFO from 1949 to 1952 (Table 8). In 1949, the Nechako River was surveyed by boat from Fort Fraser to the Grand Canyon by the Fishery Officer. In 1950 and 1951, spawning surveys were carried

TABLE 7 Nechako River chinook salmon escapement estimates 1934 - 1986 (Number in brackets is the midpoint of the range)

1934	100 - 300	(200)	1961	300 - 400[2]	(350)
1935	1000 - 2000	(1500)	1962	300 - 500	(400)
1936	500 - 1000	(750)	1963	300 - 500	(400)
1937	2000 - 5000	(3500)	1964	600 - 800[2]	(700)
1938	500 - 1000	(750)	1965	300 - 500	(400)
1939	1000 - 2000	(1500)	1966	400 - 500	(450)
1940	3000[2]		1967	500 - 1000	(750)
1941	1000 - 2000	(1500)	1968	300 - 500	(400)
942	300 - 500	(400)	1969	300 - 500	(400)
1943	100 - 300	(200)	1970	500 - 1000	(750)
1944	100 - 300	(200)	1971	300 - 500	(400)
1945	1200 - 1300[2]	(1250)	1972	300 - 500	(400)
1946	1000[2]		1973	500 - 1000	(750)
1947	No est.		1974	1424[4]	
1948	No est.		1975	1000 - 2000	(1500)
1949	2000 - 5000	(3500)	1976	1200[2]	
1950	1000 - 2000	(1500)	1977	2000[2]	
1951	2000 - 5000	(3500)	1978	2600[2]	
1952	4000[3]		1979	1800[2]	
1953	300 - 500	(400)	1980	2000[5]	
1954	1000 - 2000	(1500)	1981	1540[6]	
1955	300 - 500	(400)	1982	1448[6]	
1956	100 - 300	(200)	1983	800 - 900[2]	
1957	No est.		1984	1300[2]	
1958	No est.		1985	2000[7]	
1959	No est.		1986	2000[7]	
1960	50 - 100	(75)			

Notes

[1]Estimates from 1951 to 1986 are the data base used by the Fraser River, Northern B.C. and Yukon Division for management purposes.

[2]Specific numerical estimate by Fishery Officer
[3]Redd Count, McLaren (1952)
[4]Redd Count, Dept. of Fisheries and the Environment (1979)
[5]Mean female residence time estimate Alcan (1984)
[6]Redd Count Farina (1982b, 1983)
[7]Source: this report

Figure 8 Chinook Escapement Estimates in the Nechako River, 1949 - 1986

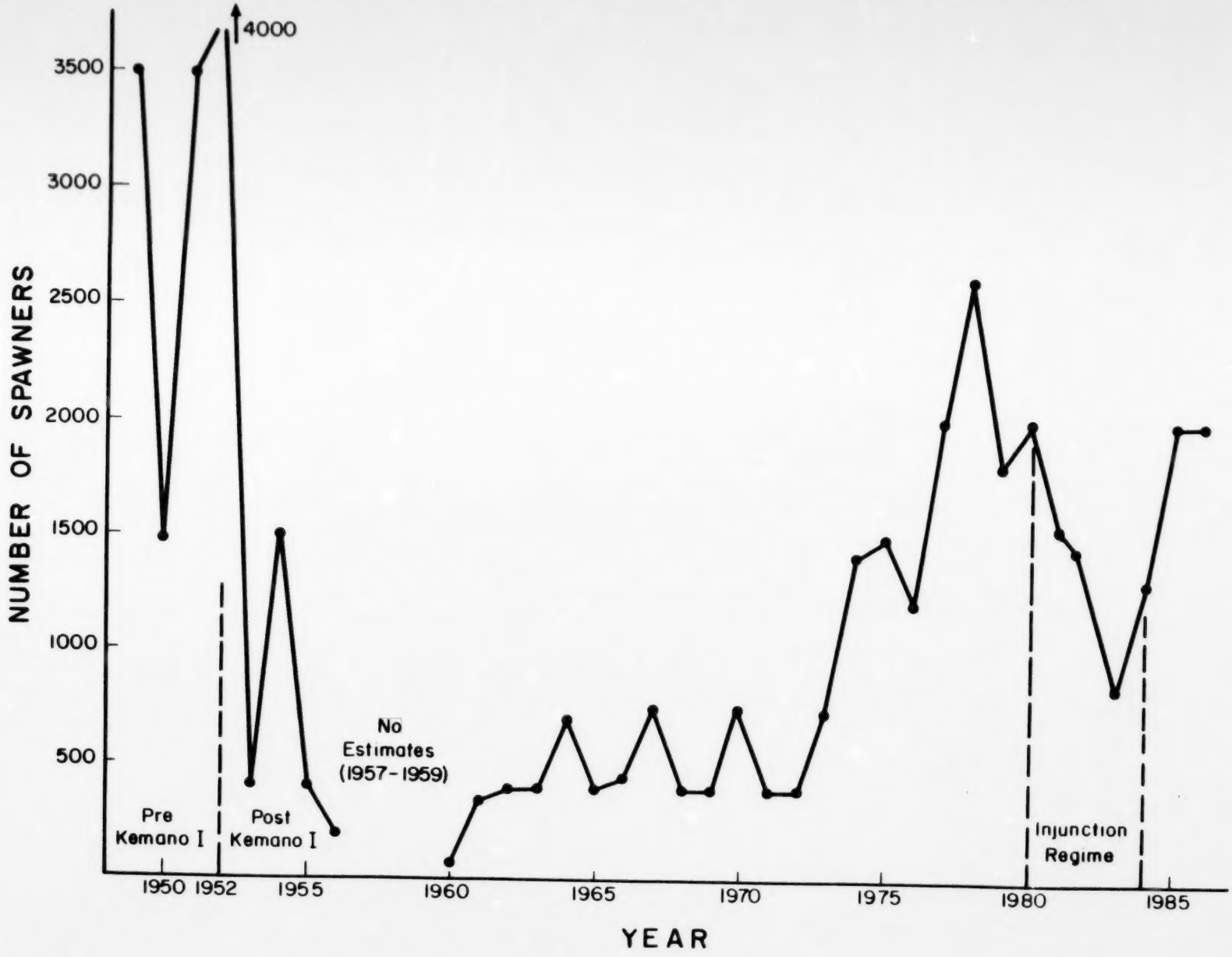


Table 8. Chinook spawner observations and redd counts for the period immediately preceding and following closure of Kenney Dam in 1952 (1949-1956).

	Upper Nechako River (above Nautley)					Nechako River (below Nautley)				
Year	Date	Spawner Count		Redd Count	Spawner Estimate (redds X2)	Date	Redd Count	Spawner estimate (redds X2)	Total Estimate	Data Source
		Live	Dead							
1949	Sept. 12-15	531	3							McLaren, 1952 (Fisheries)
	Oct. 5-9	186	1872							
1950	Sept. 15-18	507	7							McLaren, 1952
	Sept. 26-29	124	691							
	Oct. 10-13	3	159							
1951[1]	Sept. 4-7	185	3							McLaren, 1952
	Sept. 20-22	497	35							
	Oct. 5-7	3	56							
1952				1887	4000					McLaren, 1953
1952	Oct. 14			not reported	4000					Coles, 1953 (Alcan)
1953	Sept. 1-2	5								McKone, 1956 (Alcan)
	Sept. 18-19	204	3	296	592	Oct. 26	235	470	1062	
1954	Sept. 2	7								McKone, 1956
	Sept. 19-20	173	1							
	Sept. 28-29	31		457	914	Oct. 1	65	130	1044	
1955	Sept. 3-4	7								McKone, 1956
	Sept. 19-20	35		180	360	Oct. 18	213	426	786	
	Oct. 3	1								
1956	Aug. 21-22	0								McKone, 1956
	Sept. 10-11	20								
	Oct. 16			56	112	Oct. 16	108	216	328	

[1]Water silty due to dam construction.

out by the Fish Culture Development Branch and in 1952, redds were counted in the upper Nechako River when they were visible following the closure of Kenney dam (McLaren, 1952 and 1953). DFO (then the Department of Fisheries) also operated a fish counting weir on the Nechako River above Fort Fraser in 1953.

McLaren counted 1887 redds in the upper Nechako River between Fort Fraser and Cheslatta and estimated that a population of 4000 chinook spawned in this area in September 1952. Alcan agreed with this estimate based on their own surveys (Coles, 1953).

Based on the live and dead counts conducted from 1949 to 1951, McLaren speculated that the numbers of Nechako River chinook returning annually could range between 2000 and 10000 fish. He noted the large size of the river made counts difficult and that a fence count would be required to obtain an accurate population estimate. Alcan observers also reported that an accurate live count was extremely difficult due to the size of the river and depth of spawning to 4 or 5 feet (Coles, 1953).

An escapement estimate of 7500 in 1949 and 1950 was given for the upper Nechako River in a report by the Department of Fisheries, Fisheries Research Board and the Pacific Salmon Fisheries Commission (1951) and referred to in DFE (1979). The origin of this estimate is unclear. The only studies available for this period were those reported in McLaren (1952, 1953) as described above.

It is notable that in 1949, 1872 carcasses were counted in October and an escapement estimate of 2000 to 5000 spawners was reported in the stream files (BC 16's). This represents a dead count of 37% to 93% of the total estimated run. This is high based on recent experience with dead recovery in the Nechako River. Only about 10-15% of the live population were recovered in recent carcass recovery programs from 1980 to 1986 even though conditions were more favourable for recovery under injunction flows than they likely were at the higher flows in 1949. This percentage may be somewhat underestimated since the programs were terminated when about 200 carcasses were recovered. However, the target was generally achieved at the end of September or early October and after

the peak die off had occurred. In 1978, about 24% of the estimated population were recovered (Fee and Sheng, 1978). Assuming that 20% of the carcasses was counted in 1949, a population close to the 10,000 spawners as postulated by McLaren would be possible.

POST KEMANO I ESCAPEMENTS (1952-1973)

In the four years following the 1952 dam closure, there was a substantial decline of the chinook population from the 1952 estimate. The fishery officer reported 300-500 spawners in 1953 and 1955, 1000-2000 in 1954 and only 100-300 in 1956 (Table 7).

In their reports on migration and spawning in the Nechako River system (summarized in Appendix 9), Alcan reported annual redd observations from Cheslatta Falls to Vanderhoof from 1952 to 1956 (Coles, 1953; McKone, 1956). Spawner observations and redd counts in the upper Nechako River (above Nautley) and in the Nechako River (below Nautley) are shown in Table 8. These data also show a large decline in numbers of chinook particularly in the upper Nechako River. The estimates for the upper river are reasonably similar to the fishery officer population estimates. Alcan's total estimates of redds which included the Vanderhoof area were somewhat higher.

From 1957 to 1973 inclusive, the only estimates are those of the fishery officer. In all years, less than 500 or less than 1000 chinook were reported. Counts were often hampered by large discharges from the Skins Lake Spillway. Spawning flows post Kemano I were often higher than pre Kemano flows. In 1957 to 1959, no estimates were possible due to silting and Nechako River chinook were reported to spawn in the Stellako River. Alcan estimated 3478 chinook in the Stellako River in 1958 (Estabrooks 1959). The upper Nechako was often surveyed by Alcan during this period. Small numbers of live and dead chinook were reported but no population estimates were made (Appendix 9). In several years, redd observations in winter confirmed that very few chinook, if any, spawned in the upper river (Estabrooks 1959, 1963, 1964). Alcan also continued to monitor chinook in the Stellako River. Numbers ranged from 88 to 738 from

1959 to 1964, and were generally less than 100 fish from 1965 to 1976. It is only in the mid sixties that the fishery officer indicated some improvement in the visibility of the Nechako River during spawning and that surveys were conducted at the estimated peak.

RECENT ESCAPEMENTS (1974-1986)

Table 9 shows reported escapement estimates, the number of surveys conducted, reported counts of spawners, and data sources for the period from 1974 to 1986. Intensive surveys, that is, more than two helicopter surveys, were conducted in 3 years only; 1980, 1985 and 1986. Maximum counts in these three years were similar being just over 1600 chinook. Reported counts and escapement estimates in all years have generally ranged between 1000 and 2000 chinook with the exception of 1978 (2600 spawners) and 1983 with fewer than 1000 spawners reported. It should be noted that the 1981 estimate was likely grossly underestimated due to high discharges and low visibility and Alcan's estimate of 1540 based on redd counts was consequently adopted as the escapement estimate for 1981.

Even with the improvement in spawner surveys in the last few years i.e. several complete helicopter counts during spawning, low flows and improved visibility, the estimates are at best a relative index of escapement when counts were conducted during peak spawning. As shown in Table 9, only 1 or 2 counts were conducted in most years and these do not necessarily represent the peak. In years when several counts were conducted, the peak can better be determined and comparisons between years are more reliable. The peak count, however, does not represent the total escapement since it does not include chinook that spawn before or after the peak. In order to obtain a better estimate of the population, a number of methods are available. The AUC method (area under the curve) calculates the total number of spawner days (area under the spawner count vs. date of observation curve) and divides this quantity by the average residence time on the redd to estimate the total spawning population. Alternatively, methods not dependent on visual counts include mark recovery and fence counts. These methods are reviewed in Cousens et al. (1982) and Symons

Table 9. Reported chinook escapement estimates, spawner counts and data sources from 1974 to 1986. Underlined values are escapements shown in Table 7.

Year	Reported Escapement	No. of Surveys	Reported Count[1]	Date of Count	Data Sources
1974	1424	1	712 redds	Oct 1	DFE (1979)
		6	334	Sept 16	DFE (1979)
	500-1000	1	700-800	?	Fishery Officer Report
1975	1000-2000	1	1400	Sept 18-26	Fishery Officer Report
1976	1000-2000	1	1200	?	Fishery Officer Report
1977	2000-5000	1	2000+	Sept 16-20	Fishery Officer Report
1978	2402-2488[2]	2	1802[3]	Sept 12	Fee and Sheng 1978
	2000-5000	1	2600	?	Fishery Officer Report
1979	-	1	1467[3]	Sept 20	Olmsted et al., 1980
	1000-2000	2	1800	Sept 11-14	Fishery Officer Report
		1	1768	Sept 20	Envirocon Ltd., 1980
1980	-	5	1508[4]	Sept 16	Russell et al., 1983
	1000-2000	1	1600	?	Fishery Officer Report
	2000 (2023)[4]	8	1640	Sept 12	Russell et al., 1983 Alcan, 1984
1981	500[5]	2	400	Sept 17	Fishery Officer Report
	1540		768 redds		Russell et al., 1983 See Table 10
1982	1300[6]	2	1003[3]	Sept 20	McKee, F. 1982
	1300	2	975	Sept 14	Russell et al., 1983 Fishery Officer Report
	1449		724 redds		See Table 10
1983	800-900[6]	1	641[3]	Sept 19	McKee, F. pers. comm.
	800-900	1	475	Sept 19	Fishery Officer Report

Table 9. Chinook escapement estimates, peak counts and data sources from 1974 to 1986 (cont'd)

Year	Reported Escapement	No. of Surveys	Reported Count[1]	Date of Count	Data Sources
1984	1300[6]	2	1287	Sept 13	Swift, D., 1984 Fishery Officer Report
		3	852	Sept 15	Mitchell, 1984 (Envirocon Ltd.)
1985	2000[7]	4	1680	Sept 11	This report Fishery Officer Report
1986	2000[7]	4	1640	Sept 16	This report

1 Maximum count is given when there was more than 1 count, see Table 10.
2 Unclear how this estimate was derived from actual counts.
3 Includes dead; see appendix 10.
4 Based on multiple counts and female residence time.
5 Very poor conditions; fishery officer reported there could have been 4-5 times this number.
6 Actual counts are slightly expanded or rounded off by the fishery officer.
7 Peak counts are expanded by a similar factor calculated for 1980.

and Waldichuck (1984). The use of these techniques results in an increasing level of accuracy in the estimation of population size.

In 1980, Alcan (1984) estimated the Nechako chinook escapement by conducting 8 aerial counts and determining female residence time (AUC method). The estimate obtained (approx. 2000 spawners) was about 1.23 times the peak count. Neilson and Geen (1981) using this method in the Morice River noted, however, that total spawner numbers may still be underestimated since residence time was based on females, which have a longer residence time than males, and the number of jacks are also underestimated.

Multiple counts conducted by DFO were also available for 1985 and 1986. Calculation of spawner days divided by the average residence time derived in 1980 yielded estimates similar to or slightly greater than the peak. There may, however, be considerable error in these curves due to the frequency of or interval between the observations, inclusion of data points which represent incomplete surveys or counts conducted under poor conditions, and the inclusion in the counts of migrating and holding fish. Moreover, the calculation uses the average 1980 residence time which may not be applicable in other years. There was a considerable range observed in 1980 (8 to 21 days) and there was a significant difference in residence time between early and late arriving fish (Alcan, 1984). All these variables could account for substantial errors in population estimates.

Since peak counts in 1985 and 1986 were similar to 1980, the same expansion factor was used for the escapement estimate of 2000 in both years. With the exception of 1980, 1985, and 1986, it should be noted that all other reported estimates are actual spawner counts or in some cases counts that have been expanded (subjectively) by the Fishery Officer to account for fish not seen. In three years (1974, 1981, 1982), estimates were based on redd counts. The inconsistency of methods should be considered when comparisons between years are made.

Even if the AUC method is used correctly with adequate observations throughout the spawning period and an assessment of residence time, the accuracy of the method depends on the accuracy of visual counts. Healey (pers. comm.) indicates

that visual counts are almost always an underestimate of the spawners present. This conclusion is based on other systems where visual counts and estimates derived from other methods are compared. He suggests that even in a sparsely populated river like the Nechako, spawners could be underestimated by a factor of 2. In the Stuart River, Hickey and Lister (1981) demonstrate the variability in population estimates using different methods. In 1980, the Fishery Officer's spawner count at peak was 450 fish; the estimate based on peak count corrected for residence time was 590 and a mark recovery estimate, considered most reliable by the authors indicated 1837 spawners. This is about 4 times the peak count and 3 times the estimate based on residence time. Lister comments that the magnitude of the difference was surprising since the Stuart River is not particularly turbid and discharges in 1980 were 40% below average. In their summary of SEP New Projects studies, Shepherd et al. (1986) indicated that chinook escapements in the stream files were usually underestimated by 41% when compared with New Project studies where a greater effort was expended.

Another source of escapement data for this recent period is Alcan's redd counts in the upper Nechako River (above Greer Creek) from 1978 to 1985. These are shown in Table 10 and compared with the appropriate percentage of the total live count conducted by DFO. Population estimates based on redd counts from Cheslatta to Greer Creek declined from 2300 in 1978 to 1340 in 1982 and to only 220 in 1983. The 1984 and 1985 estimate was 676 and 618 spawners respectively. In some cases (1978, 1980, 1983 and 1985) there is agreement between spawner estimates based on redd counts and those based on live counts. In other years (1979, 1982 and 1984) estimates based on redd counts are considerably higher suggesting that spawner counts may have been underestimated by a factor of 1.5 to 2. In 1986, both redd counts and spawner counts were conducted by DFO and showed good agreement. The spawner estimate based on redd counts was 930 in the upper Nechako River (above Greer Creek) compared with an estimate of 888 based on live counts. Some difficulty was, however, experienced in distinguishing new redds in some areas and the accuracy of redd counts needs to be assessed further.

Table 10. Comparison of redd counts[1] and spawner estimates in the upper Nechako River from Cheslatta to Greer Creek, 1978 to 1986.

Year	Redd count	Redds X2	Spawner estimate[2]	$\frac{\text{Redd X 2}}{\text{Spawner estimate}}$
1978	1150	2300	88.9% x 2600 = 2311	1.0
1979	1050	2100	75.8% x 1800 = 1364	1.5
1980	795	1590	84.9% x 2000 = 1698	0.9
1981	768	1540	-	
1982	670 54[3]	1340 108	58.8% x 1300 = 764	1.8
1983	110 22[3]	220 44	34.8% x 850 = 296	0.7
1984	338	676	26.8% x 1300 = 348	1.9
1985	309	618	36.0% x 2000 = 720	0.9
1986 (DFO)	465	930	44.4% x 2000 = 888	1.0

[1]Redd counts conducted by Alcan except in 1986 (Estabrooks 1980a and b; Farina 1982a and b, 1983, 1984, 1985 and 1986).

[2]The spawner estimate above Greer Creek was calculated by multiplying the total escapement (Table 9) and the percentage of spawners above Greer Creek (Table 12)

[3]Additional redds 32 km downstream of Greer Creek.

ESCAPEMENT TRENDS

As shown in Figure 8, the chinook escapement declined dramatically following the construction of Kenney Dam in 1952 and remained at low levels (approximately 500 spawners) until the 1970's. The escapement estimates from 1974 to 1986 increased averaging 1666 spawners and ranging from 850 to 2600. From 1974 to 1978, numbers of chinook generally increased (1424 to 2600 spawners), declined from 1978 to 850 in 1983 and increased to about 2000 spawners in 1985 and 1986.

Table 11 shows the recent observed returns compared with expected returns assuming a 1:1 replacement of the brood. Expected returns were derived by assuming a 75:25 ratio of 5 and 4 year old fish respectively. It shows higher than expected returns in 1979 to 1981, and in 1985 and 1986, but lower than expected returns in 1982 to 1984 (the 1978 to 1980 brood years). These 3 years are also years when the intensity of surveys was relatively low. Alcan's redd counts, however, also indicate a large decline in returns in the upper river in 1983 and 1984; a decline of approximately 90% in 1983 and 66% in 1984 from the brood years. This is a substantial decrease in the escapement and it is speculated that the 1978 and 1979 brood progeny may have experienced poor survival. Age composition of the 1984 returns (age composition for 1983 returns were not available) also indicated a very poor return of five year old chinook (1979 brood progeny) which, in other years have dominated the Nechako chinook population (Table 11). Winter flows in 1979/80 were reduced to 11.3 m^3/s (400 cfs) and the colder than average winter conditions (Blachut, 1988) may have affected egg to fry survival. On the other hand, factors such as ocean survival rates or harvest rates could have affected returns.

As discussed in the previous section, these data represent reported estimates and have a number of limitations with respect to their accuracy. These numbers represent visual counts and are very likely underestimates of the true population. The extent of the error can also vary significantly from year to year depending on the number of surveys conducted during the spawning period, the timing of the survey(s), survey methods and observation conditions. Although the same fishery officer patrolled the Nechako River from 1949 to 1979 reducing

Table 11. Percentage difference between expected and actual chinook escapements in the Nechako River from 1979 to 1986.

Year	Escapement (Table 7)	Brood Years[1]	Expected[1] Return (5^+, 4^+) 75:25	% Difference	Actual % age Composition		Redds (above Greer Creek) Escapement (Redds x 2)	Expected Return	% Difference
1973					5+	4+			
1974	1424								
1975	1500								
1976	1200								
1977	2000								
1978	2600						2300		
1979	1800	1974-75	1443 (1068+375)	+24.7			2100		
1980	2000	1975-76	1425 (1125+300)	+40.4	76.1	22.3	1590		
1981	1540	1976-77	1400 (900+500)	+10.0	69.5	27.3	1540		
1982	1448	1977-78	2150 (1500+650)	-32.6	88.8	10.1	1340		
1983	850	1978-79	2400 (1950+450)	-64.6	-	-	220	2250	-90.2
1984	1300	1979-80	1850 (1350+500)	-29.7	32.5	61.2	676	1973	-65.7
1985	2000	1980-81	1885 (1500+385)	+ 6.1	70.4	28.9	618	1578	-60.8
1986	2000	1981-82	1517 (1155+362)	+31.8	64.8	29.5			

[1] Assumes that the age composition is approximately 75% and 25% of 5 year old and 4 year old chinook respectively (average of 1980, 81, 82, 85 and 86 age data).

observer bias, there is often no documentation of surveys in the stream files which allows an assessment of the precision of the estimates provided. This has improved in recent years as a result of more detailed spawning studies beginning in 1974 and the derivation of the reported estimates is available for a number of years (Table 9).

Escapements to the Nechako River are compared with escapements to the upper Fraser River and tributaries (above Prince George) in Figure 9. Average returns to the upper Fraser River were at their lowest levels in the 1960's and increased in the 1970's and 1980's. In response to the reduction of chinook harvest rates since 1980, there has been a significant increase in recent escapements to the upper Fraser River particularly from 1984 to 1986. The average escapement from 1981 to 1986 is more than double the average escapement of the previous decade. This increase, however, is not apparent in the Nechako River; the average escapement for 1981 to 1986 is slightly higher than the 1971 to 1980 average (1523 vs. 1407 spawners). Although the Nechako River escapements have increased from 1983 to 1985, similar to other stocks, Harrison (pers. comm.) notes that Nechako chinook salmon spawning escapements since 1983 are more depressed than the spawning escapement to most other Upper Fraser River tributaries using 1979 to 1982 as a base period for comparison.

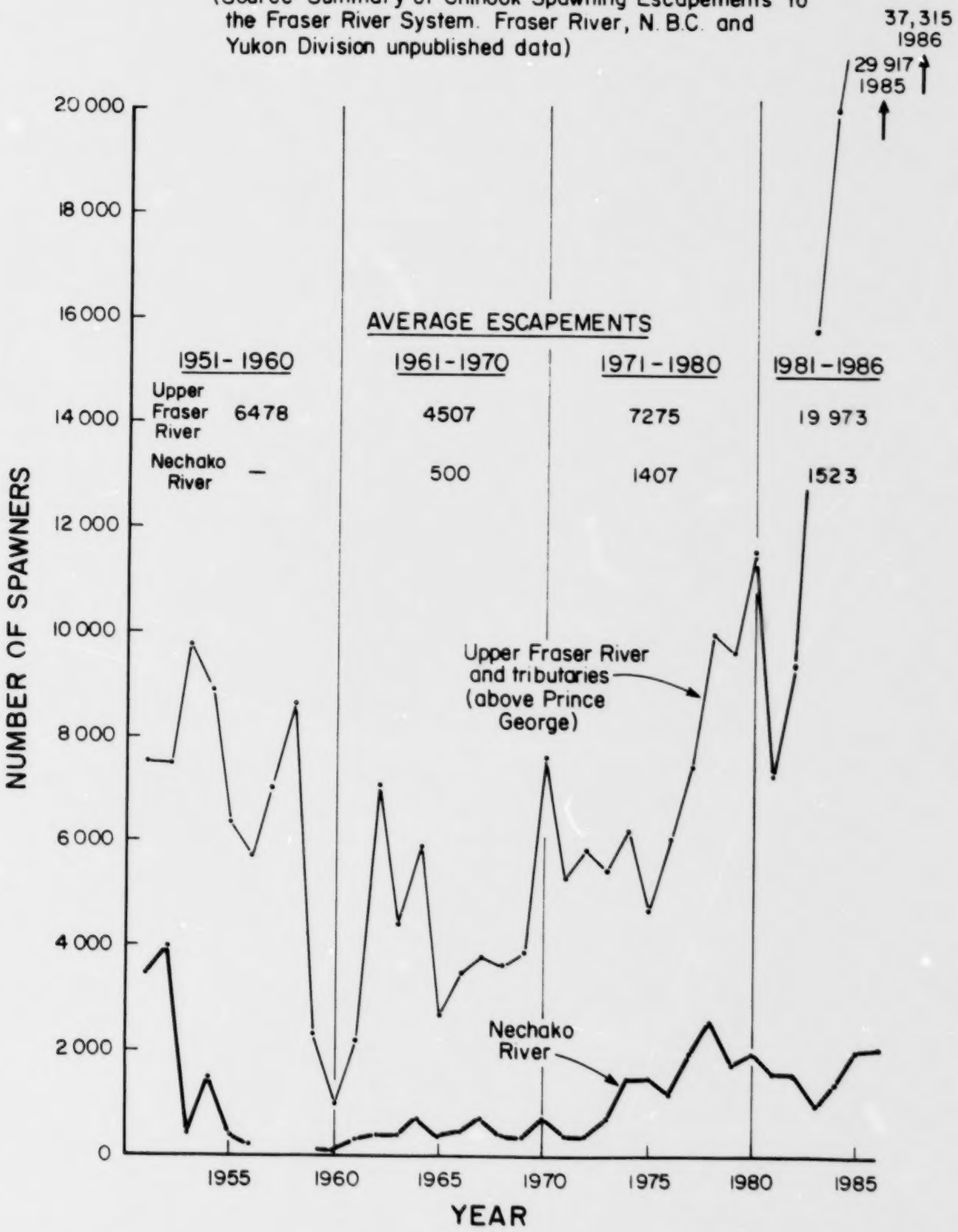
DISTRIBUTION OF SPAWNERS

Prior to McLaren's studies in 1951, the distribution of spawners in the Nechako River was generally described in the Fishery Officer reports. Spawning grounds were "40 to 60 miles" above Fort Fraser and "1 to 6 miles" above Vanderhoof. Sketches show the spawning areas as upstream of Greer Creek, and in the vicinity of Hill Larson's and Diamond Island. In 1951, McLaren produced a detailed map of the Nechako River from Cheslatta to Nautley showing spawning areas (McLaren, 1952). He described their distribution as follows:

> "From Cheslatta Canyon to Swanson Creek there are many long stretches where water flows moderately fast over a bottom composed of medium to coarse gravel. The most important area is located in the mainstream

Figure 9 Chinook Escapements to the Upper Fraser River and Tributaries and to the Nechako River, 1951 – 1986.

(Source: Summary of Chinook Spawning Escapements to the Fraser River System. Fraser River, N.B.C. and Yukon Division unpublished data)



near where Twin Creek discharges into the Nechako River. In addition, there are many other excellent areas dispersed throughout this region which is heavily populated by spawning salmon. From Swanson Creek to Fort Fraser, the spawning areas are fairly widely dispersed. They are located in the main channel and to a large extent near mouths of small tributary creeks. With the exception of these isolated areas, this section does not appear to be too suitable for spawning."

Based on the redd count from Fort Fraser to Cheslatta in 1952, McLaren found that 81.6% of the redds were located between Cutoff Creek and Cheslatta Canyon (McLaren 1952).

Following closure of Kenney Dam from 1952 to 1956, a greater number of chinook spawned in the Vanderhoof area than in the upper Nechako River (Coles 1953 ; McKone 1956). Although the total population was greatly reduced, close to equal numbers in 1953 or greater numbers of fish in 1955 and 1956 spawned in the Vanderhoof area than in the upper Nechako River. The exception was 1954, with 87.5% of the spawners in the upper river. This change in distribution was likely related to the dramatic reduction in flow and habitat in the upper river during these years. In 1953, 1955 and 1956, the spawning flows in the upper Nechako River were only 17.1, 8.1 and 9.7 m^3/s (604, 286 and 342 cfs) while in 1954, spawning flows were slightly higher being 28 m^3/s or close to 1000 cfs.

In the 1960's, little detail is given on chinook distribution in the Nechako River. The fishery officer reported that chinook were returning to their traditional areas as the water cleared following the period of initial releases from the Skins Lake Spillway in 1957. As noted earlier, Nechako chinook were believed to have spawned in the Stellako River during this period. In 1974, the fishery officer noted a change in distribution with more chinook in the vicinity of Vanderhoof and Engen than he had ever encountered. Spawning flows in 1974 were reduced to 27.8 m^3/s (981 cfs), which were similar to 1954 flows. In his spawning report, the fishery officer noted that:

> "In all the years prior to 1974, some 60 to 70 percent of the Spring (chinook) run to the Nechako (Vanderhoof to Cheslatta Falls) has always spawned above Fort Fraser. This year, possibly due to low water conditions and higher than normal water temperatures only some 40 to 45 percent of the run spawned above Fort Fraser. The number of springs seen in the areas some 5 miles above Vanderhoof was the best this writer has seen since 1952."

Studies in 1974 also indicated that only 45% of the chinook spawned above Fort Fraser and 55% below Fort Fraser (DFE, 1979). The redd count, however, did show a slightly higher percentage in the upper river (65%).

From 1978 on, spawning surveys included a more detailed documentation of distribution. Beginning in 1980, DFO divided the river into 16 sections (Fig. 2) for counting purposes. The percentage distribution of spawners can therefore be separated into upper (above Greer Creek), middle (Greer Creek to Fort Fraser) and lower river (Fort Fraser to Vanderhoof) for comparison during most years.

The percentage distribution for 1974 and 1978 to 1986 inclusive is shown in Table 12 and Figure 10. In general, over 80% of the chinook spawned in the upper river from 1978 to 1982. Based on redd counts in 1978, Fee and Sheng (1978) reported that 81% of all spawning in the upper Nechako River occurred in a 5.8 km area upstream of Bert Irvine's Lodge (approximately km 5 - km 11). Studies in 1979 also indicated that the most intensive spawning activity was in a study area that extended several kilometers upstream and downstream of Bert Irvine's Lodge (approximately km 5 - km 15). Spawners in this area represented about 58% of the chinook in the Nechako River above Nautley and almost 50% of the total Nechako population (Olmsted et al., 1980). Redd superimposition, indicating some of the areas were at capacity, was also reported for this area particularly in the spawning area bordering Bert Irvine's lodge.

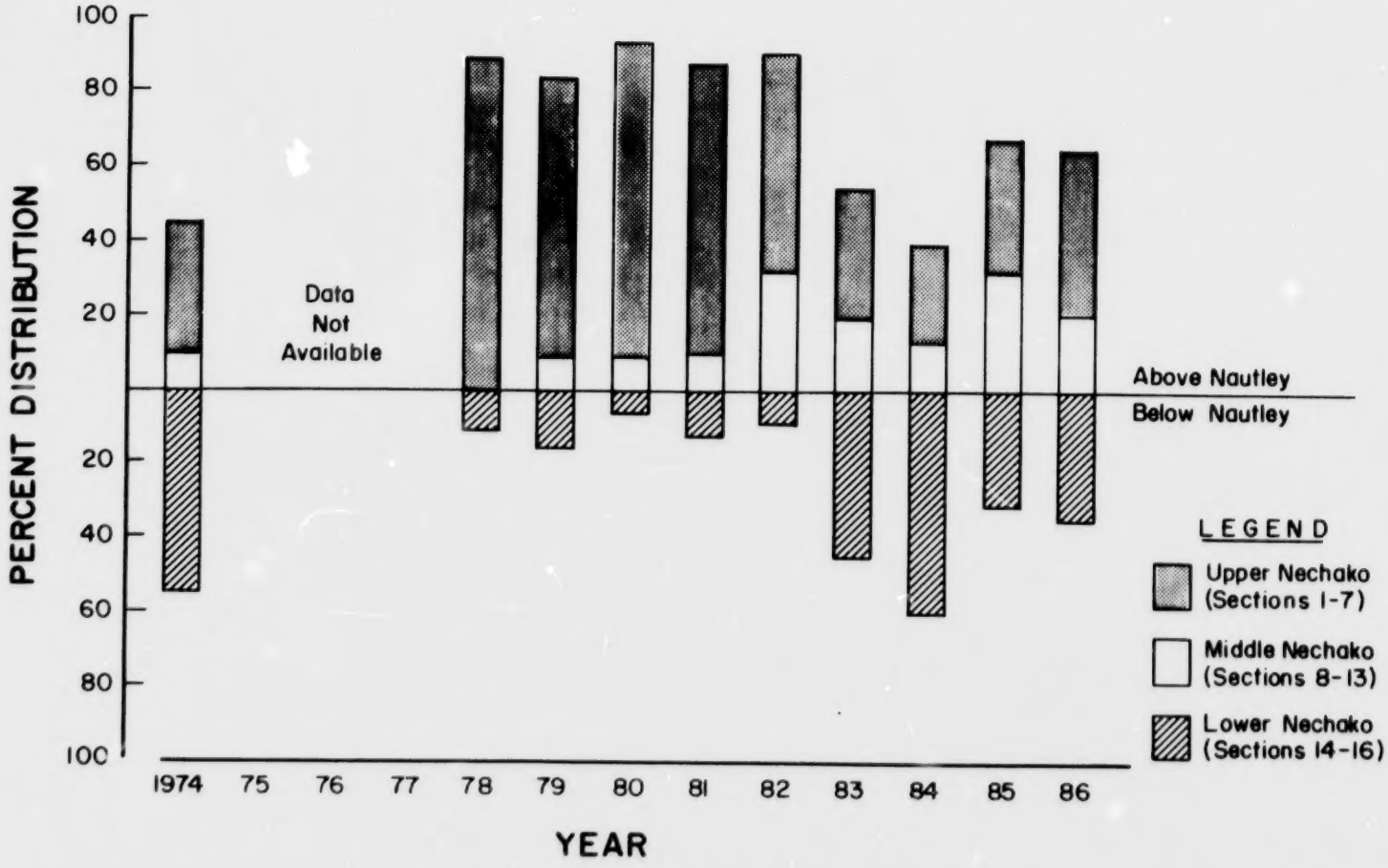
From 1983 to 1986, the percentage of spawners in the upper river spawning areas was considerably reduced particularly in 1983 and 1984 when 45.4 and 60.2%

Table 12. Percentage distribution of Nechako River Chinook spawners, 1974-1986.

Date	Upper Nechako Section	Middle Nechako	Lower Nechako	Spawner counts Date	Number	Source
	(1 - 7)	(8 - 13)	(14 -16)			
1974	35.0	9.9	55.1	Sept. 16	334	DFE (1979)
1974[1]	57.3	8.4	34.3	Oct. 1	1424	DFE (1979)
1975	Distribution data not available					
1976	Distribution data not available					
1977	Distribution data not available					
1978	88.9	none reported	11.1	Sept. 12	1802 (L+D)[2]	Fee and Sheng, 1978
1979	75.8	8.5	15.7	Sept. 20	1467 (L+D)	Olmsted et al., 1980
	86.3	2.8	10.9	Sept. 19	1768	Envirocon Ltd., 1980
1980	84.9	8.8	6.4	Sept. 16	1508 (L+D)	Russell et al., 1983
	71.4	20.5	8.1	Sept. 4-20	7407[4]	Alcan (1984)
1981[3]	77.5	10.0	12.5	Sept. 17	400	Fishery Officer Report
1982	58.8	32.0	9.2	Sept. 20	1003 (L+D)	McKee, F., 1982
1983	34.8	19.8	45.4	Sept. 19	641 (L+D)	McKee, F. (pers. comm.)
1984	26.8	13.0	60.2	Sept. 13	1287	Swift, D., 1984
1985	36.0	32.3	31.7	Sept. 11	1680	This report
1986	44.4	20.9	34.7	Sept. 16	1640	This report
1986[1]	56.2	21.9	22.0	Oct. 10	1656	This report

1 Spawner estimate based on number of redds multiplied by 2.
2 Live and dead counts.
3 Very poor visibility.
4 Total of 8 surveys; percent distribution based on total counts in each section.

Figure 10 Percent Distribution of Chinook Spawners in the Nechako River from Cheslatta Falls to Vanderhoof, 1974 - 1986



respectively of the chinook spawned in the lower Nechako River. The percentage of spawners in the major spawning areas in the Upper Nechako above Greer Creek that were well populated in 1978, 1979 and 1980 was only 26.8 to 34.8%. In 1985 and 1986, the chinook population was more evenly represented in the upper, middle and lower river with a slightly larger percentage of spawners in the upper Nechako above Greer Creek.

The historical distribution data indicates that reductions in flow during reservoir filling affected spawning distribution by limiting spawning habitat in the residual upper Nechako River. In 1974, during low flows (less than 28.3 m^3/s; 1000 cfs) the Fishery officer reported a change in the migration and distribution of chinook. In other systems, changes in spawning distribution have also been associated with changes in discharge. Significant changes in spawner distribution for example, have been reported for the Quesnel River and were attributed to changes in stream discharge and habitat selectivity (Shepherd et al., 1986). Even though escapements were similar, approximately 40% of the 1980 Quesnel River spawners utilized areas not spawned on in 1979.

The recent changes in distribution in the Nechako River are less clearly associated with spawning flows. In 1978, spawning flows were reduced to levels similar to 1974 and remained at these levels through 1984 and in 1986 (32.6 to 42.3 m^3; 1150 to 1500 cfs). A change in spawner distribution however was not observed until 1983 and 1984. As indicated earlier, it is possible that the 1978 and 1979 brood progeny experienced poor survival in the upper river which resulted in very low returns to the upper river in 1983 and 1984. Both spawner and redd counts indicated a significant decline in numbers in the upper Nechako, and the age composition data for 1984 showed a very poor return of the 5 year old age class, that normally dominate the run (Table 5). It is noteworthy that the 5+ fish were the progeny of the 1979 brood that would have incubated during low winter flows in 1979 (11.3 m^3/s (400 cfs)). The winter of 1979/80 was colder than average and may have contributed to reduced egg to fry survival.

Although, flow, temperature and other physical variables can affect adult migration and spawning habitat suitability, there were no obvious changes in 1983 and 1984. It is interesting to note that the distribution of Nechako River chinook was very similar in 1985 and 1986 even though the spawning flow in 1985 was almost double the 1986 flow. The relative numbers of spawners in the upper river increased in 1985 and 1986; however, the percentages are considerably lower than those observed prior to 1983.

While there have been differences in the relative distribution of spawners, the spawning areas have been consistently used despite the large flow variations following Kemano I. This is apparent from comparison of historical and present distribution data, notably a distribution map prepared in 1951 (McLaren, 1952), recent counts of spawners and redds, and interpretation of aerial photos. Main spawning areas are characterized by large accumulations of gravel or spawning dunes, which can be identified on aerial photographs. Aerial photos taken in 1953, 1974, 1978, 1980, 1981 and 1986 shows that many of the spawning sites are stable over time (Rood, 1987). Sites identified from the 1953 photography were also identified on most of the more recent photographs. These sites appear to be used repeatedly and constitute the major spawning areas in the Nechako River from Fort Fraser to Cheslatta Falls (Figure 11).

The traditional spawning areas are very similar to sites observed in 1986 (Figure 4). The most intensive spawning occurs in the upper river, including the upper spawning study site (km 7) and Bert Irvine's (km 10); spawning is dispersed below Greer Creek to pockets around Hill Larson's and Diamond Island; and in the lower river occurs mainly at Engen and Vanderhoof. Although the areas below Nautley do not have good aerial photo coverage, recent observations of spawning areas are consistent with observations reported in the historical stream records.

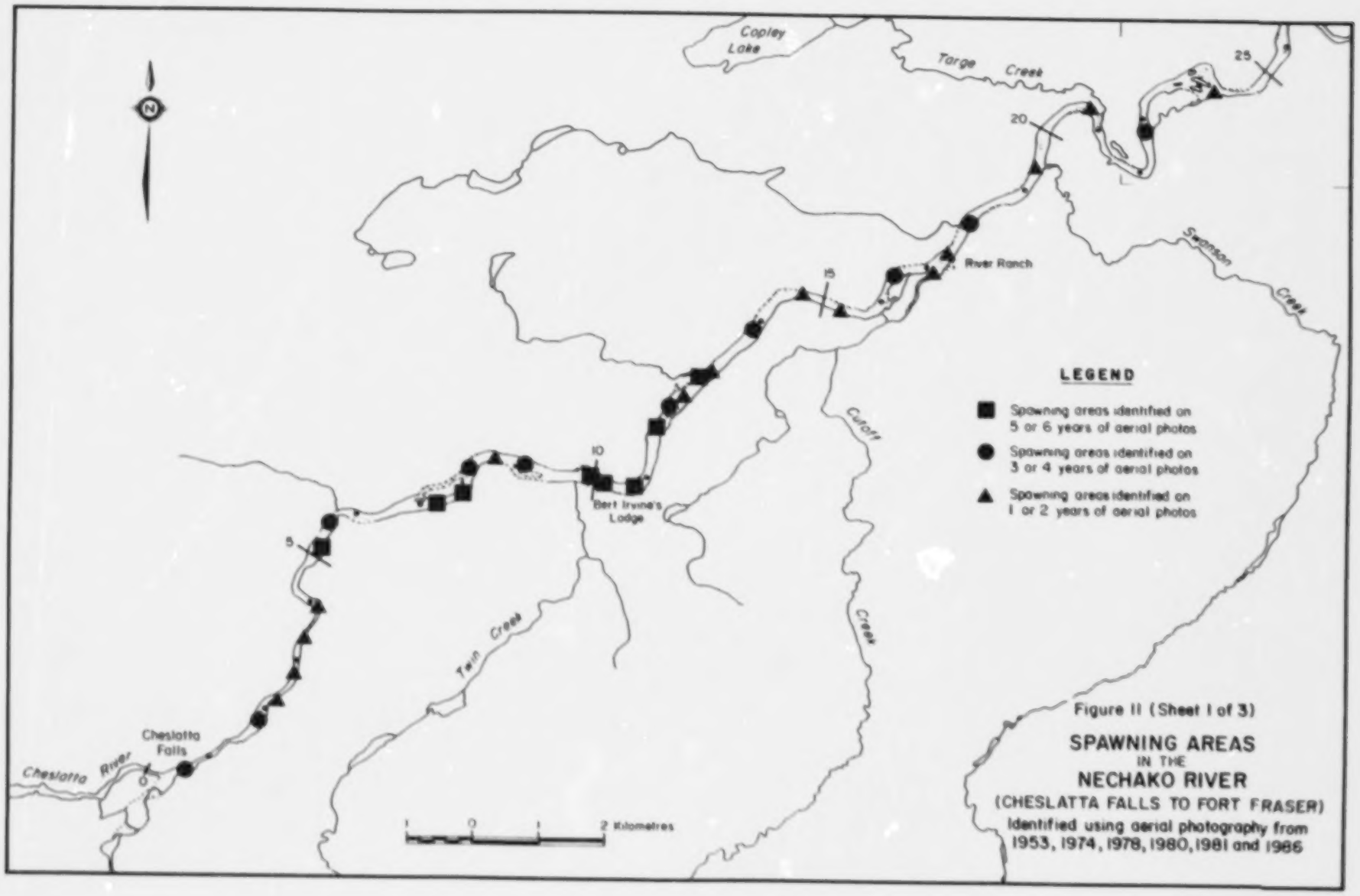


Figure 11 (Sheet 1 of 3)

SPAWNING AREAS
IN THE
NECHAKO RIVER
(CHESLATTA FALLS TO FORT FRASER)
Identified using aerial photography from 1953, 1974, 1978, 1980, 1981 and 1986

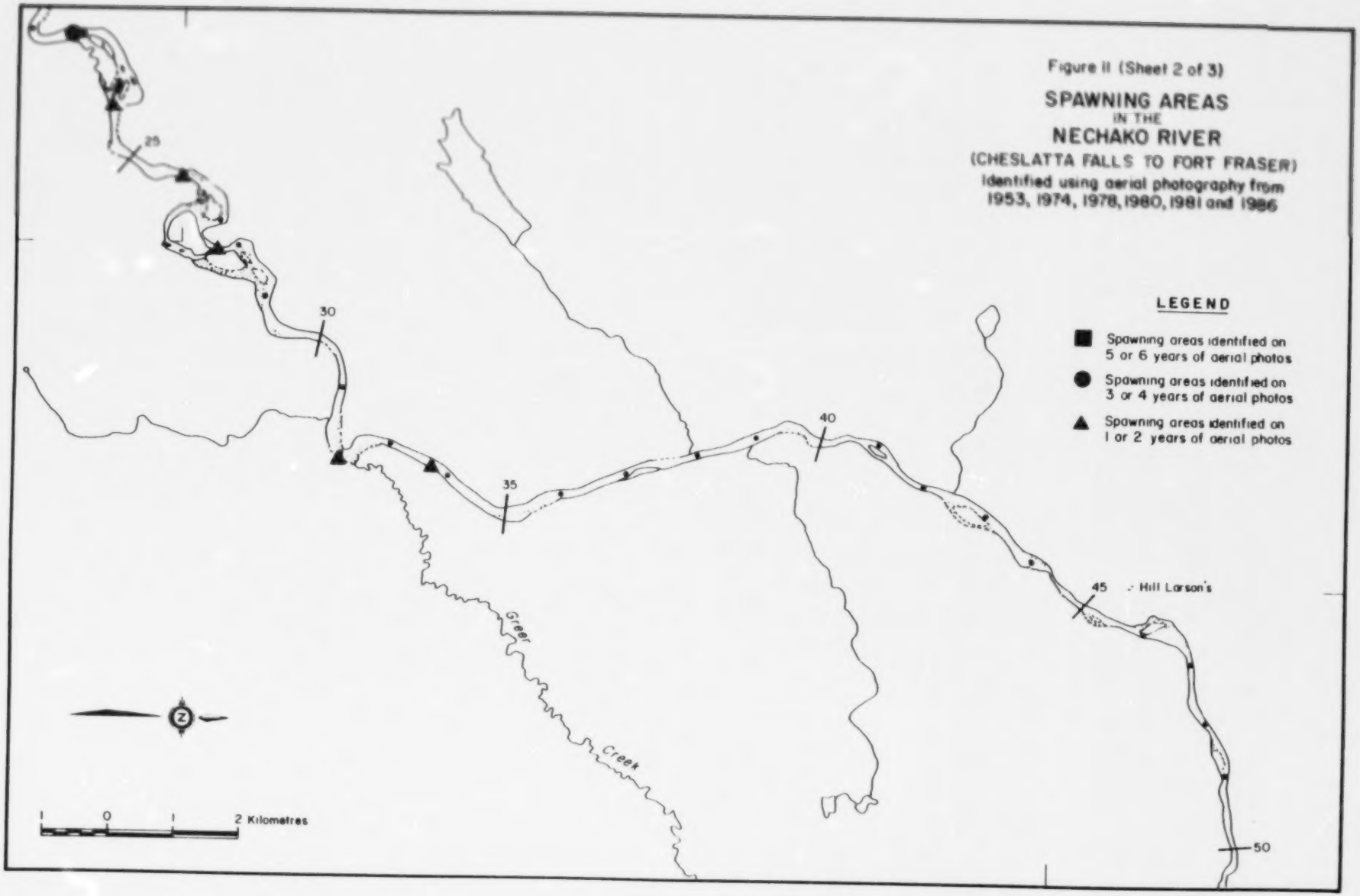


Figure II (Sheet 2 of 3)
SPAWNING AREAS
IN THE
NECHAKO RIVER
(CHESLATTA FALLS TO FORT FRASER)
Identified using aerial photography from
1953, 1974, 1978, 1980, 1981 and 1986
LEGEND
Spawning areas identified on 5 or 6 years of aerial photos
Spawning areas identified on 3 or 4 years of aerial photos
Spawning areas identified on 1 or 2 years of aerial photos
25
30
35
40
45
50
Hill Larson's
Greer Creek
N
0
1
2 Kilometres

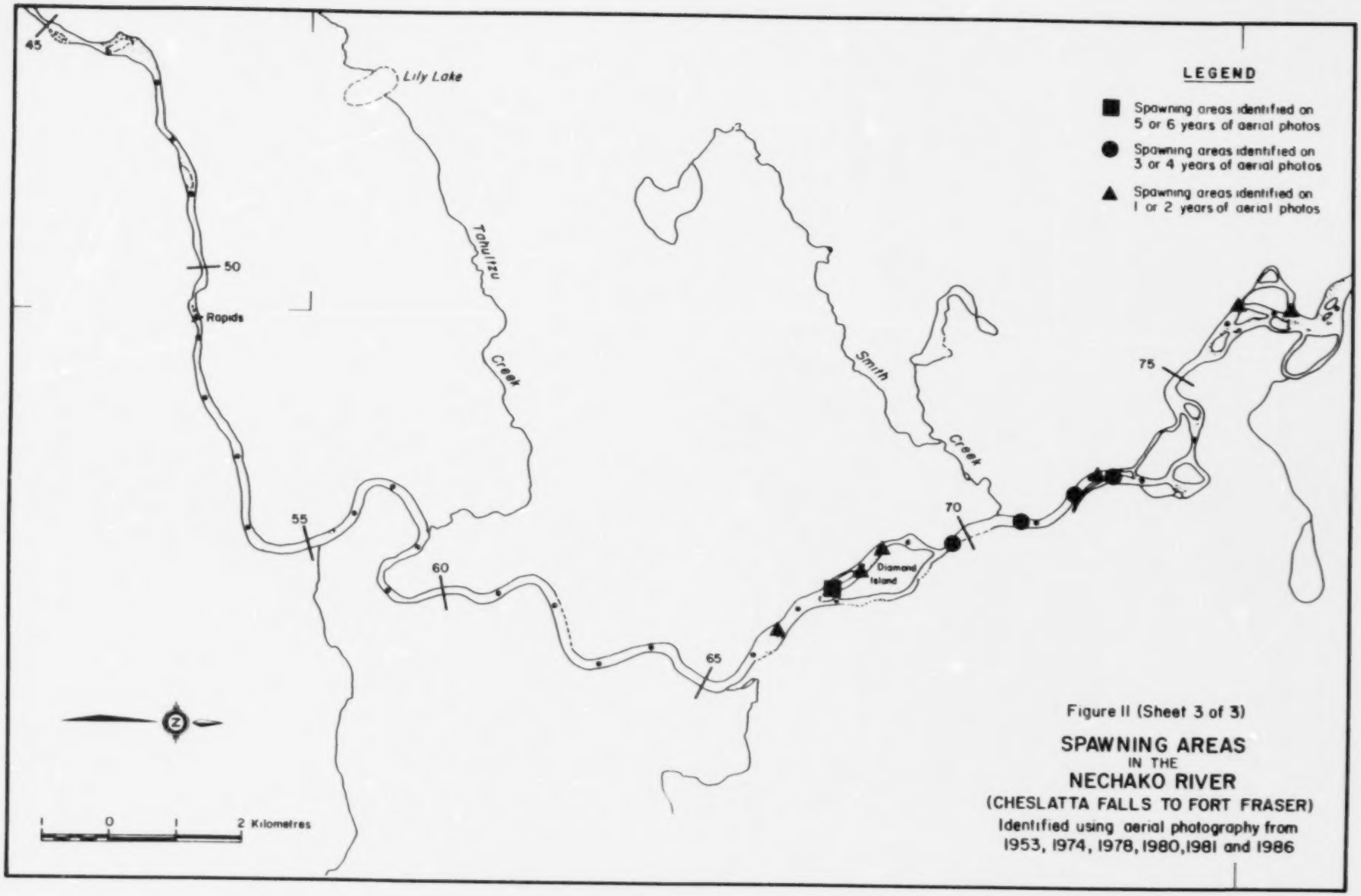


Figure II (Sheet 3 of 3)

SPAWNING AREAS
IN THE
NECHAKO RIVER
(CHESLATTA FALLS TO FORT FRASER)
Identified using aerial photography from
1953, 1974, 1978, 1980, 1981 and 1986

SPAWNING HABITAT CHARACTERISTICS

SPAWNING DUNES

The spawning areas for chinook salmon in the Nechako River are characterized by spawning dunes. These are a series of elevated bands of gravel oriented perpendicular to the flow, with approximately regular spacing and amplitude. The dunes are created by spawning chinook during redd building. Tutty (1986) described "multiple redds" in the Nechako River in 1974. He made detailed observations of spawner activity in the upper and lower spawning study sites (km 7 and km 9) in relation to dunes. He observed the creation of a new dune, the enlargement or branching of an existing dune and the reuse of an existing dune.

In their studies of Nechako River chinook spawners at the upper and lower spawning sites, Neilson and Banford (1983) also reported that redds were distributed along gravel ridges or dunes. Rood (1987) plotted redd locations surveyed in 1974, 1980 and 1986 on a map of spawning dunes and showed a close association of most redds with dunes.

Spawning dunes are not unique to the Nechako River. Huntington (1985) describes spawning dunes in the Deschutes River, Oregon and includes examples of other chinook spawning rivers in the Pacific Northwest with characteristic dunes. Generally, they are found in rivers downstream of lakes or in regulated rivers. In B.C., the Morice River and the Chilko River exhibit dunes. Huntington indicated that the dunes may increase the downwelling of water through the gravel containing the eggs and that the trough provides favourable holding conditions for spawners.

In a report on aspects of Nechako River geomorphology, Rood (1987) describes dune characteristics, area, location and stability using selected aerial photography from 1953 to 1986. The following analysis is taken from this report.

Based on detailed mapping of the upper spawning study site where redd surveys had previously been conducted, Rood reported that the dune wavelength or spacing averaged about 13m and amplitudes were generally less than 0.75m and many less than 0.5m. The total dune area as measured from aerial photographs, represented

only about 1% of the channel bottom between Cheslatta Falls and Vanderhoof. It should be noted however that this percentage is underestimated since all areas could not be identified on aerial photos. In particular, sites in the lower river where spawning is known to occur were not identifiable on aerial photos.

The area of dunes identified on photos was estimated by Rood to be about 148000 m^2 from Cheslatta Falls to Fort Fraser. Neilson and Banford (1983) estimated the density of redds in the upper and lower spawning areas to be 1 redd/235 m^2 and 1 redd/112 m^2 respectively. These areas were considered to have a relatively high density based on aerial surveys of the entire river. Using these densities, and assuming 2 spawners/redd, 1260 to 2643 spawners would be accommodated on the estimated area of existing spawning grounds. These values indicated a much lower density than would be estimated using redd area or defended area (3 or 4 times redd area) as described in the literature (Burner, 1951). Redd area measured in the Nechako River by Alcan (1984) averaged 10 m^2 ranging from 0.4 to 33.5 m^2.

Densities are dependent on escapement size which in 1980 was estimated to be about 2000 spawners. This is somewhat less than the escapement in 1978 of 2600. Based on their field observations, Fee and Sheng (1978) indicated that some prime spawning areas in 1978 were close to capacity. Olmsted et al. (1980) observed redd superimposition on the lower spawning study site during 1979 when the escapement was estimated to be 1800 chinook.

PHYSICAL REDD CHARACTERISTICS

Ground surveys of redds at selected spawning areas have been conducted over several years (DFE, 1979; Russell et al., 1983; Alcan, 1984; Dutta, 1987; and Hamilton, 1987). The purpose of these studies was to determine the spawning depth and velocity preferences of chinook in the Nechako River and to assess the effect of changes in spawning and incubation flows. The upper (site 3) and lower (site 4) study sites have been surveyed most intensively (Figure 12). Redd locations were plotted in 1974, 1980 and 1986 and spawning depths and velocities determined. As noted in Figure 12 boundaries of the study areas have changed from year to year. In 1985 and 1986, additional sites were surveyed including sites downstream of Bert Irvine's Lodge, downstream of Swanson Creek,

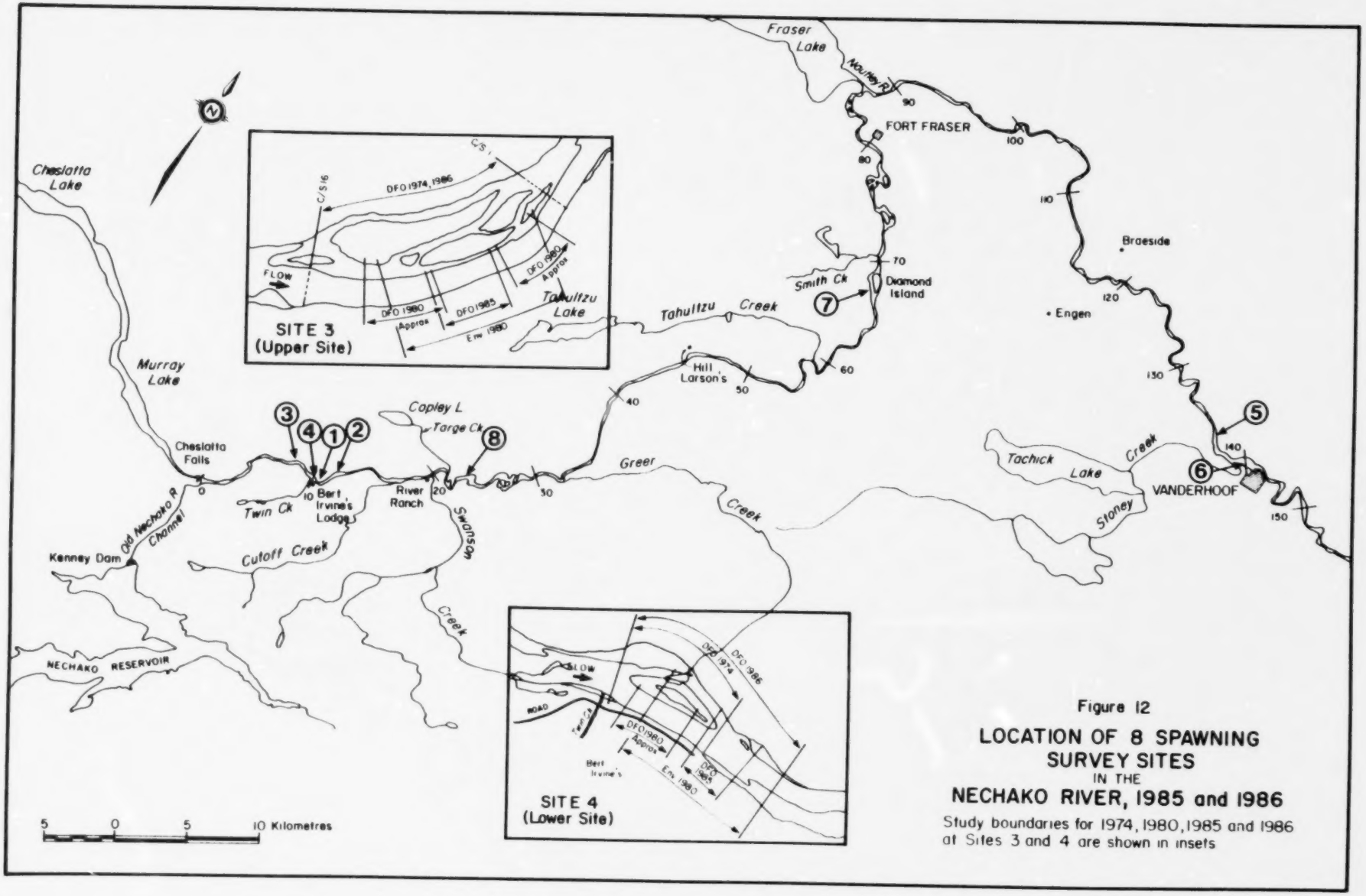


Figure 12

LOCATION OF 8 SPAWNING SURVEY SITES IN THE NECHAKO RIVER, 1985 and 1986

Study boundaries for 1974, 1980, 1985 and 1986 at Sites 3 and 4 are shown in insets

at Diamond Island and Vanderhoof. In both years, the depths over the crests of all redds in these study sites were measured. In 1986, some velocity profiles were also measured.

Table 13 shows the mean depth of redds and the depth to the crest of redds for 1974, 1978, 1980, 1985 and 1986. In all years with the exception of 1985, spawning flows were of similar magnitude. Three sets of data (1974, 1980 and 1986) indicated a mean redd depth of about 0.80 meters. DFO's measurements for 1980 (Russell et al., 1983) indicated a shallower mean depth of 0.64 m. Comparisons between studies, however, should be made cautiously since the methods, study sites and number of redds measured have varied. In 1974, for example, spawning depths were determined by super-imposing surveyed redd locations onto depth contour maps (DFE, 1979). In all other years, redds judged to be active were measured directly. Because the depths and velocities vary significantly along the dune profile, the precise location of measurement is important. In the 1980 and 1986 DFO studies, redd depths were measured at a point adjacent to the excavated area or pot (i.e. near the spawning fish but on the undisturbed gravel). Depth measurements by Alcan (1984) on the other hand, were taken on the undisturbed bottom slightly upstream of the pot. In 1978, the method of measurement of redd depths was not described.

Depth to the crest or top of redds is likely more consistently measured by different investigators and the data therefore more readily compared. Mean depth to the redd crests ranged from 0.32 m in 1978 to 0.53 m in 1980. Depth distributions to the crest of redds at sites 3 and 4 and at all 8 study sites are shown in Figures 13 and 14 respectively. Mean crest depths in 1985 were greater than in 1986. Hamilton (1987) indicated that the shallower mean crest depths measured in 1986 compared to 1985 reflect the lower water level (about 0.24 m) in 1986 and suggests that the chinook spawned in similar locations. Figure 13 also shows the difference in the two sets of depth data for 1980.

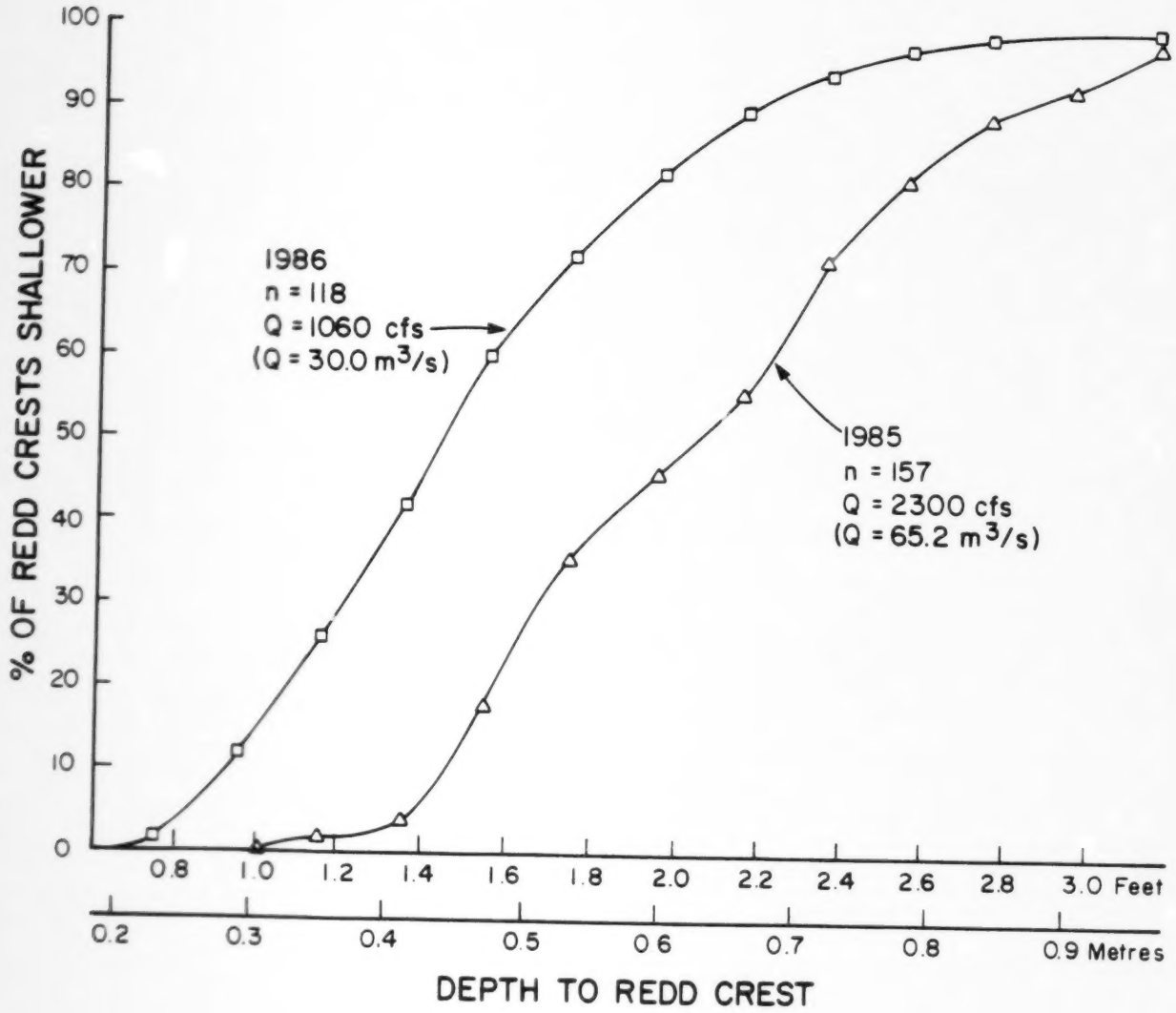
Table 14 provides a summary of nose velocities measured at chinook redds at sites 3 and 4 in 1974, 1980 and 1986. Mean velocities were quite consistent

Table 13. Mean depth of redds and depth to crest of redds of Nechako River chinook, 1974-1986.

Year	Mean Sept. flow m^3/s	Mean Sept. flow cfs	Study Site (Fig. 12)	n	Depth of redd (m) $\bar{X}$	Depth of redd (m) Range	Depth of crest (m) $\bar{X}$	Depth of crest (m) Range	Source
1974	27.8	981	3	67	0.77[1]	0.46-1.1			DFE, 1979
			4	34	0.84	0.61-1.1	Not available		
			Total	101	0.80	0.46-1.1			
1978	34.2	1207	Sites between Cheslatta and Cut-off Creek	93	0.55[2]	0.33-0.85	0.32	0.23-0.41	Fee & Sheng, 1978
1980	36.2	1278	3	25	0.58[3]	0.37-0.85	0.39	0.21-0.76	Russell et al, 1983
			4	14	0.75	0.64-0.91	0.46	0.30-0.64	
			Total	39	0.64	0.37-0.91	0.41	0.21-0.76	
1980			3	30	0.74[4]	0.40-1.1	0.52	0.24-1.1	Alcan, 1984
			4	32	0.82	0.60-1.0	0.55	0.34-0.80	
			Total	62	0.78	0.40-1.1	0.53	0.24-1.1	
1985	64.4	2273	3	14			0.58	0.30-0.79	Hamilton, 1987
			4	11	Not Available		0.69	0.52-0.79	
			Total	25			0.63	0.30-0.79	
			All 8 sites	157			0.63	0.30-0.98	
1986	32.6	1151	3	19	0.82[5]	0.58-1.1	0.53	0.18-0.79	Dutta, 1987
			4	24	0.78	0.52-1.0	0.48	0.24-0.67	Hamilton, 1987
			Total	43	0.80	0.52-1.1	0.51	0.18-0.79	
			All 8 sites	118			0.46	0.18-0.91	

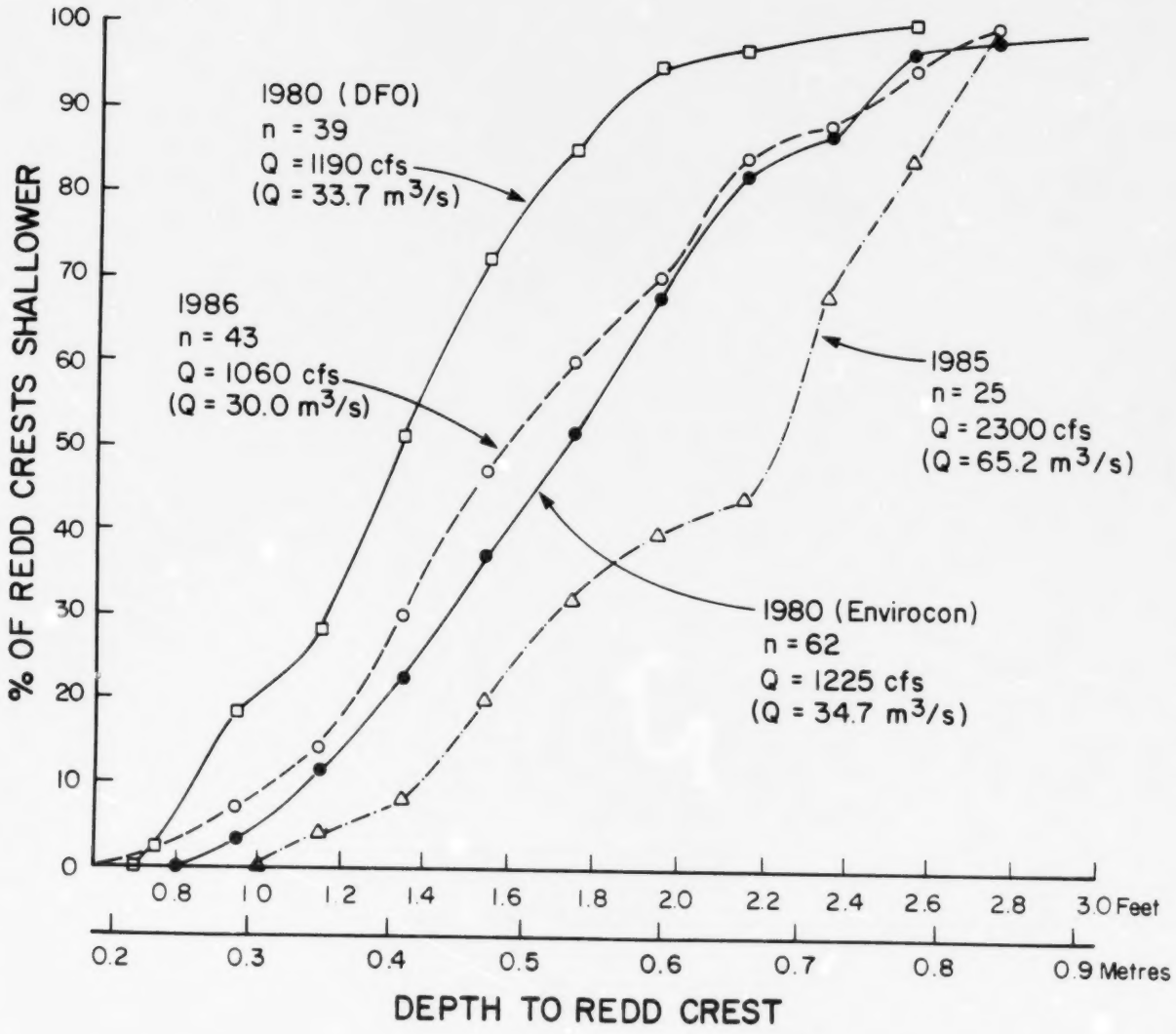
1 redd depths were not measured directly; surveyed redd locations were plotted onto a depth contour map.
2 depths are referred to as 'front' depth; it is not clear where the measurement was taken relative to the pot.
3 redd depths were measured adjacent to the pot i.e., near the spawning fish but on the undisturbed gravel.
4 redd depths were measured slightly upstream of the pot.
5 redd depths were measured adjacent to the pot.

Figure 13 Cumulative Distribution of Depth to Crest of Redds at Sites 1 to 8 in the Nechako River



Source: Hamilton (1987)

Figure 14 Cumulative Distribution of Depth to Crest of Redds at Sites 3 and 4 in the Nechako River



Source: Hamilton (1987)

Table 14. Mean nose velocities measured at chinook redds in the Nechako River, 1974-1986.

Year	Mean Sept. flow m^3/s	cfs	Study Site (Fig. 12)	n	Nose Velocity (m/s) $\bar{x}$	Range	Source
1974	27.8	981	3	67	0.56[1]	0.41-0.72	DFE, 1979
			4	34	0.66	0.54-0.76	
			Total	101	0.59	0.44-0.75	
1978	34.2	1207	Sites between Cheslatta and Cut-off Creek	93	-	0.52-0.98	Fee & Sheng, 1978
1980	36.2	1278	3	25	0.7[2]	0.4-1.1	Russell et al., 1983
			4	14	0.7	0.5-0.8	
			Total	39	0.7	0.4-1.1	
1980			3	30	0.61[3]	0.30-1.05	Alcan, 1984
			4	32	0.64	0.15-0.90	
			Total	62	0.62	0.15-1.05	
1985					No Velocity Data		
1986	32.6	1151	3	19	0.48[4]	0.21-0.76	Dutta, 1987
			4	24	0.64	0.34-0.98	
			Total	43	0.55	0.21-0.98	

[1] Velocities at the redd were extrapolated from velocities measured along transects in the spawning area. Surface velocities were measured and converted to nose velocities.

[2] Nose velocities were measured slightly upstream from the pot 12 cm above the substrate.

[3] Nose velocities were measured slightly upstream from the pot 15 cm above the substrate.

[4] Nose velocities were measured slightly adjacent to the pot 12 cm above the substrate.

averaging about 0.59 m/s in 3 data sets (DFE, 1979; Alcan 1984; and Dutta, 1987). The 1980 data presented in Russell et al. (1983) are somewhat higher (0.7 m/s).

Similar to redd depth measurements, measurements of redd velocities are not standardized among the studies. In 1974, velocities were not measured directly at the redd but extrapolated from transect measurements. In 1980, most velocity measurements were taken upstream of the pot either 12 or 15 cm from the bottom in DFO's and Alcan's studies respectively. In 1986, nose velocity measurements were taken adjacent to the pot about 15 cm from the bottom (Dutta, 1987). In 1978, surface velocities were measured and nose velocities were derived using a conversion factor. It is not clear at what position the velocities were taken.

Compared with depths and velocities preferred by spawning chinook reported in the literature, the Nechako River chinook appear to utilize deeper and faster water (DFE, 1979; Alcan, 1984). However, due to the configuration of dunes and changes in depth and velocity along the dune profile, the depth and velocity criteria for Nechako River chinook may not be directly comparable to other studies, particularly with respect to reported minimum depths of spawning.

Substrate composition of spawning gravels is reported in Russell et al. (1983) for both artificially created experimental redds as well as natural redds. On average, less than 5% of the sample weight consisted of particle sizes equal to or less than 0.25 mm (medium sand). Average gravel size is not available since the fraction larger than sand was not separated into size classes. Envirocon (1982) reported that samples taken from 2 redds averaged about 3% sand (less than 2 mm) ranging from 0.1 to 5.3%. While the sample sizes and weights are likely not adequate to provide unbiased results, indications supported by field observations are that the percentage of fines (equal to or less than 1 mm) is relatively low and would therefore be conducive to good egg-to-fry survival (Russell et al., 1983).

Alcan (1984) also sampled substrate in 18 and 29 active redds in the upper and lower spawning sites respectively. Results of these analyses are expressed as

Fredle indices which are indicators of sediment permeability. High permeability of spawning gravels has been correlated with improved egg-to-fry survivals (Reiser and Bjornn, 1979). Alcan (1984) reported a mean Fredle index of 5.6 which correlates with a high survival rate based on studies of coho and steelhead. Variability among redds was, however high (0.6-22.8) even among replicates (Neilson and Banford, 1982). This suggests some problems in sampling precision possibly due to small sample size. Other than the Fredle index, the particle size composition of these redds is not presented in the above reports.

Neilson and Banford (1982) investigated chinook spawner characteristics in relation to redd physical features. They found that the location of redds corresponded with the spawning dunes along the river bottom. Distribution across the channel resulted from the interaction between spawning females. They also noted that early arriving chinook constructed larger redds, selected the deeper, slower spawning sites characterized by higher Fredle indices and remained on the redds longer. Later arriving chinook spawned in relatively shallow, fast-flowing water and had a shorter residence time. The authors postulated that the progeny of the early arriving spawners may have a selective advantage over the progeny of late arriving fish based on selection and defence of the most favorable spawning sites.

SPAWNER BIOLOGICAL CHARACTERISTICS

The data from carcass recovery programs in the Nechako River from 1980 to 1986 are presented in Appendix 6 (carcasses were not recovered in 1983). Sex, postorbital-hypural length, age and egg retention are presented. It should be noted that some transcription errors were found in the 1980, 1981 and 1982 data as reported in Russell et al. (1983) and corrected data are presented here. Analysis of carcass recovery data collected prior to 1980 is presented in the form available in the original reports, since the raw data were either unavailable or incomplete. All scales that were available at the scale lab were, however, reread and these readings are reported along with the age composition presented in the original reports.

AGE COMPOSITION

Four and five year old fish with one full year in freshwater dominated the spawning population of Nechako River chinook sampled from 1974 to 1986 (Table 15). From 1980 to 1986, with the exception of 1984, 5 year olds predominated ranging from 64.8% to 86.9% of the spawning population. In 1984, 5 year olds represented only 32% of the population.

Analysis of age composition prior to 1980 is limited to 1974 and 1978; in other years the percentage age composition may not be representative due to a small sample size. Age interpretation prior to 1980 is also complicated by changes in scale reading since 1980. Age composition reported in DFE (1979) and Fee and Sheng (1978) showed a predominance of 4 year old fish, a greater number of 3 year old fish and a higher percentage of sub 1 chinook than observed in the more recent data from 1980. However, when these scales were reread in 1984, the percentage of older fish and sub 2 fish increased and were more consistent with the recent data. This was the result of changes in the criteria for aging natural chinook stocks based on additional information from the return of known aged chinook, smolt sampling and increased experience of scale readers (Y. Yole, 1984).

To overcome the problems of reading and interpreting scales that are often resorbed, Chilton and Bilton (1986) recommend that both scales and fin rays be used to estimate age of spawning chinook. They found good agreement in reading of freshwater age between the two methods but believe that fin ray analysis is more appropriate for total age.

As discussed in Part I both scales and fin rays were collected in the Nechako River in 1984. Using both methods, 4_2 fish dominated the population although a larger percentage (61.2%) were designated as four year olds by scale reading compared with fin analysis (46.8%) (Tables 5 and 6). Of the 140 samples for which both readable scales and fin rays were available, 100 (71.4%) agreed in age while 40 did not. In the majority of the cases of disagreement, the age estimates from fin rays were higher than age estimates from scales. For example, fin ray analyses indicated that 19.3% of the population were 6_2's while

TABLE 15 Percentage age composition of Nechako River chinook salmon sampled from 1974 to 1986.

Year	Source	Sex	Readable n	Age Composition (%) 3 1	3 2	4 1	4 2	5 1	5 2	6 2	Not Readable	Total Sample Size
1974	DFE(1979)	M				not available						
		F				not available						
		Total	115	2.6	20.9	2.6	43.5	0	30.4	0	80	
1974[1]		Total	92	2.2	14.1	0	30.4	0	53.3	0		
1976	DFE(1979)	Total	1						100	0		
1977	DFE(1979)	Total	18	11.1	11.1	16.7	27.8	0	33.3	0		
1977[1]		Total	18	0	0	0	38.9	0	61.1	0		
1978	Fee and	M	49	20.4	6.1	18.4	34.7	0	20.4	0		
	Sheng(1978)	F	99	24.2	0	28.3	24.2	1.0	21.1	1.0		
		Total	148	23.0	2.0	25.0	27.7	0.7	20.9	0.7	58	
1978[1]		Total	145	1.4	4.1	5.5	24.1	0.7	63.4	0.7		
1979[2]	Olmsted	M	9	22.2	0	44.4	11.1	22.2	0	0	5	
	et al.	F	19	15.8	0	47.4	21.0	5.3	10.5	0	1	
	(1980)	Total	28	17.9	0	46.4	17.9	10.7	7.1	0	6	
1980[3]	Russell	M	63	0	3.2	11.1	15.9	3.2	66.7	0	10	
	et al.	F	117	0.9	0	10.3	9.4	0	79.5	0	10	
	(1983)	Total	180	0.6	1.1	10.6	11.7	1.1	75.0	0	20	
1981	Russell	M	62	0	0	4.8	16.1	0	75.8	3.2	10	
	et al.	F	99	1.0	1.0	3.0	28.3	1.0	64.6	1.1	7	+1
	(1983)	Total	161	0.6	0.6	3.7	23.6	0.6	68.9	1.9	17	178
1982[3]	Russell	M	90	0	0	0	7.8	0	90.0	2.2	10	
	et al.	F	86	0	0	0	16.3	0	83.7	0	14	
	(1983)	Total	176	0	0	0	11.9	0	86.9	1.1	24	200
1983		Age data not available.										
1984	This report	M	69	0	4.3	1.5	55.1	0	34.8	4.3		
		F	78	0	0	1.3	66.7	0	29.5	2.5		
		Total	147	0	2.0	1.4	61.2	0	32.0	3.4	31	178

TABLE 15 (con't) Percentage age composition of Nechako River chinook salmon sampled from 1974 to 1986.

Year	Source	Sex	Readable n	Age Composition (%) 3 1	3 2	4 1	4 2	5 1	5 2	6 2	Not Readable	Total Sample Size
1985	This report	M	47	0	0	0	40.4	0	59.6	0		
		F	95	0	0	1.0	23.2	0	75.8	0		
		Total	142	0	0	0.7	28.8	0	70.4	0	42	184
1986	This report	M	65	0	3.1	0	20.0	0	70.8	6.1		
		F	74	0	0	0	37.8	0	59.5	2.7		
		Total	139	0	1.4	0	29.5	0	64.8	4.3	66	205

[1] Scales re-aged.
[2] Scales were unavailable and were therefore not reread.
[3] Corrections made to ages reported in Russell et al. (1983). For 1980, errors were in appendix 31 and Table 17 and in 1982 in Table 17 only.

only 3.4% of the scales were designated as 6 year old fish. A small percentage (4%) were also designated as 7 and 8 year olds by the fin ray method. Independent scale analysis (Fish Morphology Laboratory and Pacific Biological Station) indicated one year of freshwater residence for the majority of fish (97%).

LENGTH COMPOSITION

Length composition of Nechako River chinook from 1974 to 1986 is shown in Table 16. Mean POHL lengths of females ranged from 66.9 cm to 71.6 cm and males from 65.7 to 74.7 cm. The mean lengths of chinook in 1974 and in 1984 were the lowest of all years sampled. This is consistent with age composition data and reflects a larger percentage of 3 and 4 year old fish in 1974 and the dominance of 4 year olds in 1984. In all other years, 5 year old fish were the strongest component.

FECUNDITY AND EGG RETENTION

Fecundity of eight chinook females sampled in the Nechako River between 1978 and 1985 averaged 5769 eggs/female (range 5000 - 7200 eggs/female, Table 17). Mean postorbital-hypural length of those females was 68.2 cm (range 61.1-76.0 cm, Table 17). Egg retention sampled between 1980 and 1986 averaged 19 eggs/female (annual mean range <1-38 eggs/female, individual range 0-1600 eggs/female, Table 18).

TABLE 16 Mean postorbital-hypural length of Nechako River chinook spawners by sex and year; 1974 to 1986

Year	Length (cm) ± 1 Standard Error		
	Males (n_m)[1]	Females (n_f)	Total ($n_m + n_f$)
1974[2]	65.7 ± n/a (75)[3]	68.2 ± n/a (88)	
1978[2]	70.4 ± 0.5 (226)[3]	69.0 ± 0.3 (351)	
1979[4]	90.4 ± 31.8 (21)	84.5 ±13.0 (23)	87.4 ± n/a (44)
1980[5]	71.8 ± 1.2 (73)	71.4 ± 0.4 (127)	71.5 ± 0.5 (200)
1981[5]	72.2 ± 1.0 (72)	68.4 ± 0.8 (107)	70.0 ± 0.6 (179)
1982[5]	75.1 ± 0.5 (100)	70.2 ± 0.6 (100)	72.7 ± 0.4 (200)
1984	68.1 ± 1.1 (81)	66.9 ± 0.7 (97)	67.4 ± 0.6 (178)
1985	73.1 ± 1.1 (63)	71.6 ± 0.5 (121)	72.1 ± 0.5 (184)
1986	74.7 ± 0.7 (101)	68.0 ± 0.6 (104)	71.3 ± 0.5 (205)

Legend: n_m Number of males sampled
n_f Number of females sampled
n/a Data not available

Notes:

1 includes jacks unless otherwise specified
2 source Fee and Sheng (1978) Tables 6 and 8
3 does not include jacks
4 source: Olmsted, et al. 1980 Table 3 N.B. mean fork length is given
5 source: Russell, et al. 1983

Table 17. Fecundity of chinook in the Nechako River, 1978-1980, 1985.

Year	Eggs/female	Postorbital-hypural length (mm)	Source
1978	5250	684	Fee and Sheng (1978)
	6305	663	
1979	7200	703	Olmsted et al. (1980)
	5313	611	
	5284	611	
1980	5000[1]	710	Russell et al. (1983)
	5000[1]	710	
1985	6800	760	This report
Mean	5769	682	-

[1] Method of counting not reported.

Table 18. Egg retention in chinook females in the Nechako River, 1980-1982, 1984-1986.

Year	Sample size	Eggs retained/female[1]	
		Mean	Range
1980	110	12	0-850
1981	107	<1[2]	0-6
1982	100	10	0-350
1984	97	21	0-1200
1985	120	38	0-600
1986	104	30	0-1600
Mean	638	19	0-1600

[1] Data for 1980-1982 extracted from Russell et al. (1983).
[2] Only two females retained 1 and 6 eggs each.

SUMMARY

PART I: SPAWNING SURVEYS 1983-1986

1. Estimated Nechako River escapements have increased from 850 spawners in 1983 to 2000 spawners in 1985 and 1986. These estimates are based on visual surveys. Only 1 and 2 counts were conducted in 1983 and 1984 respectively. The surveys in 1985 and 1986 were more intensive and peak counts of 1680 and 1640 were expanded by a factor of 1.2 to obtain an escapement estimate of 2000 spawners.

2. Both spawner counts and redd counts were conducted in 1986. In the upper Nechako River where active redds could be identified, the spawner estimate based on redd counts was similar to the escapement estimate based on live counts. Redd counts after spawning is complete may serve as a useful method to estimate number of spawners in the upper Nechako River but the accuracy of redd counts needs to be assessed further.

3. The relative distribution of spawners in the upper and lower Nechako has varied. In 1983 and 1984, a smaller percentage of chinook spawned in the upper river (55 and 40%) than in 1985 and 1986 (68 and 65%).

4. Mean lengths for all fish averaged 67.4 cm in 1984, 72.1 cm in 1985 and 71.3 cm in 1986. The mean length for 1984 was significantly smaller ($p<0.05$) and is likely the result of the dominance of younger fish; age 4 and younger fish constituted 64.6% of the 1984 recoveries but only 29.6 and 30.9% of the 1985 and 1986 recoveries respectively. This suggests a poor return of the 1979 brood progeny.

5. Four and five year old chinook that spent one full year in freshwater dominated the spawning population in all years with age 4 sub 2 dominant in 1984 and age 5 sub 2 dominant in 1985 and 1986. Age determination by fin ray analyses in 1984 indicated an overall older age composition of chinook

compared with scale analyses. The dominant age class, however, remained the same. Four year old chinook comprised 48.0% and 62.6% of the 1984 spawners based on fin and scale analyses respectively.

6. The sex ratio of sampled carcasses (female:male) ranged from 1.0 to 1.9. Mean egg retention was low; only 19 out of 321 carcasses retained over 100 eggs.

PART II: REVIEW OF HISTORICAL AND RECENT DATA ON CHINOOK SPAWNING POPULATIONS IN THE NECHAKO RIVER

1. Reported pre-Kemano escapements were in the order of 2000 to 5000 chinook. Nechako River chinook declined during reservoir filling from 1952 to 1956. For a decade following the Kemano I project, very few chinook spawned in the upper river and in a few years were reported to spawn in the Stellako River instead. The population was reduced to less than 1000 fish and less than 500 chinook in some years. Populations remained depressed until the 1970's.

2. The Nechako chinook escapement began an increasing trend in the 1970's and a maximum of 2600 chinook was reported in 1978. Since that time, estimates based on visual counts have averaged about 1600 chinook spawners with a low of 850 in 1983 and a high of 2000 in 1980, 1985 and 1986.

3. Although Nechako chinook spawning escapements since 1983 have increased, they are depressed compared with most other upper Fraser River chinook stocks (above Prince George) using 1979 to 1982 as a base period for comparison. The increase in other upper Fraser River stocks is attributed to the reduction of chinook harvest rates.

4. Reported escapements are likely underestimates of the true population since they are based on visual counts, the reliability of which depends on the number, timing and methods of surveys as well as flow and weather conditions. Moreover, the escapement estimates do not always provide a population index that can be compared from year to year because methods have not been consistent.

5. Chinook redds are associated with dunes in the spawning areas. These dunes are created by chinook spawning activities and form long gravel ridges perpendicular to the river flow.

6. The location of spawning areas has been relatively consistent since the pre-Kemano I period. In general, the major spawning grounds occur in the upper Nechako River particularly above Greer Creek and accommodate the majority of spawners in most years. Downstream of Greer Creek, spawning areas are more scattered and sites include Diamond Island, Engen and Vanderhoof. The location of major spawning areas was noted in the historical records and confirmed on the basis of the presence of dunes by analyses of aerial photographs taken from 1952 to 1986.

7. Some changes in the relative distribution of spawners have occurred. During reservoir filling from 1952 to 1956 more fish spawned in the Vanderhoof area than was noted prior to the construction of the dam. Recent distributions also show an increase in the percentage of spawners in the lower river. Less than 20% of chinook spawned in the lower river from 1978 to 1982. Since 1983, the percentage of spawners in the lower river has ranged from just over 30% in 1985 to 1986 to as high as 45% and 60% in 1983 and 1984 respectively. The relationship to spawning flow is not clear since flows were similar during this recent period. The poor escapement to the upper Nechako in 1983 and 1984 may be due to poor survival of the 1978 and 1979 brood progeny. The age composition of chinook returns in 1984 also indicated a poor return of 5 year old fish (1979 brood progeny). Very low flows and freezing conditions in the winter of 1979 may have contributed to reduced survivals. Alternatively, ocean survival rates or harvest rates could have resulted in lower than expected returns.

8. Spawning depths and velocities have been measured over several years at two study sites in the upper Nechako River. Overall mean depth of redds at discharges of 27.8 to 36.2 m^3/s (981 to 1278 cfs) has ranged from 0.64 to 0.80 m and the mean depth to the crest of redds ranged from 0.41 to 0.53 m. Mean nose velocities have ranged from 0.55 to 0.7 m/s. Crest depths were also measured at additional downstream sites in 1985 and 1986. In 1986 the mean crest depth was 0.46m and in 1985 averaged 0.63m reflecting the higher discharge of 64.4 m/s (2274 cfs).

9. Substrate samples from spawned redds indicate a relatively low percentage of fines; however, the small number of samples and sample volume limit the accuracy and precision of results.

10. Available age composition data indicates that 5 year old chinook dominated the spawning population in most years with the exception of 1974 and 1984 and almost 100% of the returning adults remained in freshwater for one year as juveniles.

11. Mean length of females ranged from 66.9 cm to 71.6 cm and males from 65.7 cm to 74.7 cm. Mean lengths in 1974 and 1984 were the lowest and likely reflect the younger age composition of spawners in these years.

12. Fecundity of eight chinook averaged 5769 eggs. The lengths of females sampled ranges from 61.1 to 76 cm. Observations on egg retention of carcasses since 1980 indicates that spawning success is high.

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Appendix 1. Chinook spawning escapements in upper, mid and lower Nechako reaches, 1983-1986 (DFO data).

Year	Date	Location and DFO Section number						Total
		Upper Nechako			Mid Nechako		Lower Nechako	
		1-2	3	4-7	8-10	11-13	14-16	
1983	Sept 19	34	120	69		127	291	641[a]
1984	Sept 4	0	82	28	5	42	151	308[b]
	Sept 13	40	170	135	42	125	775	1287[b]
1985	Sept 7	1	399	305	52	282	254	1293
	Sept 11	14	299	292	95	447	533	1680
	Sept 18[c]	7	127	16	0	112	119	381
	Sept 26	11	72	24	6	39	82	234
1986	Sept 3	13	76	87	-[d]	-[d]	102[e]	278[f]
	Sept 10	25	232	484	58	143	189	1131
	Sept 16	92	332	304	195	148	569	1640
	Sept 23	137	327	318	139	119	241	1281

[a] Fishery Officer count; includes 67 dead.

[b] Source: Swift, D. (DFO Memo 1984, File 5170-51-S1).

[c] Poor viewing conditions.

[d] Not flown.

[e] Only section 16 was flown in this reach.

[f] Incomplete survey since river section from Diamond Island to just above Vanderhoof was not flown.

Appendix 2. Daily chinook escapement counts by river section in the Nechako River, September 1984.[a]

Section		September 4		September 13	
		Count 1	% of Total	Count 1	% of Total
1	Cheslatta Falls	0	0	30	2.3
2		0	0	10	0.8
3		82	26.6	170	13.2
4		2	0.6	40	3.1
5		20	6.5	45	3.5
6		6	1.9	50	3.9
7	Greer Cr.	0	0	0	0
8		0	0	0	0
9		0	0	30	2.3
10		5	1.6	12	0.9
11		42	13.6	18	1.4
12		0	0	60	4.7
13		0	0	47	3.7
14	Nautley R.	20	6.5	125	9.7
15		51	16.6	250	19.4
16	Vanderhoof	80	26.0	400	31.1
Total		308	100.0	1287	100.0

[a] From DFO Memo (File 5903-85-N75) by D. Swift (Fishery Officer), September 17, 1984.

Appendix 3. Daily chinook escapement counts by river section in the Nechako River, September 1985.

Date and time : September 7, 1985, 1100-1300 h

Flying conditions : Excellent; clear skies, little or no wind

Viewing conditions: Good to excellent; river clear, some wind on sections 1 to 4. Observations from Vanderhoof to Cheslatta Falls

Section	Count 1	Count 2	Corrected Count[a]	% of Total	Comments
1 Cheslatta Falls	1	0	1	0.1	
2	0	0	0	0	
3	428	370	399	30.9	
4	168	144	156	12.1	
5	106	123	115	8.9	
6	31	37	34	2.6	
7 Greer Cr.	0	0	0	0	
8	44	54	49	3.8	
9	0	0	0	0	
10	3	3	3	0.2	
11	221	216	219	16.9	
12	11	49	49	3.8	In sections 12-16,
13	10	14	14	1.1	count 2 was used
14 Nautley R.	37	49	49	3.8	as corrected
15	43	50	50	3.9	count since
16 Vanderhoof	74	155	155	12.0	Observer 2 was
Total	1177	1264	1293	100.0	more experienced

[a] Unless otherwise noted, the corrected count is the average of two observed counts.

Appendix 3. (cont'd)

Date and time : September 11, 1985, 1000-1200 h

Flying conditions : Excellent

Viewing conditions: Variable, mostly good/excellent; <5% poor due to sun glare/windows, some smoke from fires. Observations from Vanderhoof to Cheslatta Falls

Section	Count 1	Count 2	Corrected Count[a]	% of Total	Comments
1 Cheslatta Falls	9	9	9	0.5	
2	0	5	5	0.3	Observer 1 distracted
3	298	300	299	17.8	
4	25	25	25	1.5	
5	56	64	60	3.6	
6	127	188	188	11.2	Observer 1 distracted
7 Greer Cr.	17	20	19	1.1	
8	20	16	18	1.1	
9	18	30	30	1.8	Observer 1 distracted
10	23	47	47	2.8	Observer 1 distracted
11	192	189	190	11.3	
12	186	147	186	11.1	Observer 1 distracted
13	74	68	71	4.2	
14 Nautley R.	118	126	121	7.2	
15	153	190	172	10.2	
16 Vanderhoof	239	241	240	14.3	
Total	1555	1665	1680	100.0	

[a] Unless otherwise noted, the corrected count is the average of two observed counts.

Appendix 3. (cont'd)

Date and time : September 18, 1985, 1100-1400 h

Flying conditions : Fair to poor; weather poor, windy and rainy

Viewing conditions: Fair to poor; sections 5-11 particularly poor; ripples on water. Observations from Vanderhoof to Cheslatta Falls

Section	Count 1	Count 2	Corrected Count[a]	% of Total	Comments
1 Cheslatta Falls	0	6	3	0.8	
2	1	7	4	1.0	
3	123	130	127	33.3	
4	5	13	9	2.4	
5	5	6	6	1.6	Counts in sections
6	0	2	1	0.3	5 - 11 dubious as
7 Greer Cr.	0	0	0	0	weather particu-
8	0	0	0	0	larly poor
9	0	0	0	0	
10	0	0	0	0	
11	66	54	60	15.7	
12	42	25	42	11.0	Count 1 from
13	10	15	10	2.6	sections 12 - 16
14 Nautley R.	1	6	1	0.3	was used as
15	12	16	12	3.1	corrected count
16 Vanderhoof	106	62	106	27.8	since Observer 1 was more experienced
Total	371	342	381	99.9	

[a] Unless otherwise noted the corrected count is the average of two observed counts.

Appendix 3. (cont'd)

Date and time : September 26, 1985, 1140-1445 h

Flying conditions : Good, partially overcast, gusty

Viewing conditions: Variable, mostly good. Observations from Cheslatta Falls to Vanderhoof

Section	Count 1	Count 2	Corrected Count	% of Total	Comments
1 Cheslatta Falls	4	4	4	1.7	
2	13	1	7	3.0	
3	77	68	72	30.8	
4	13	9	11	4.7	
5	7	5	6	2.6	
6	3	10	6	2.6	
7 Greer Cr.	0	1	1	0.4	
8	0	5	3	1.3	
9	3	0	1	0.4	
10	2	2	2	0.9	
11	19	18	18	7.7	
12	23	18	21	9.0	
13	0	0	0	0	
14 Nautley R.	0	2	1	0.4	
15	31	17	24	10.3	
16 Vanderhoof	64	50	57	24.4	
Total	259	210	234	100.2	

[a] Unless otherwise noted, the corrected count is the average of two observed counts.

Appendix 4. Daily chinook escapement counts by river section in the Nechako River, September 1986.

Date and time : September 3, 1986, 1200 - 1600 h

Flying conditions : Fair

Viewing conditions: Fair

Section		Count 1	Count 2	Mean Count	% of Total	Comments
1	Cheslatta Falls	0		0	0	
2		13	NOT	13	4.7	
3		76	DONE	76	27.3	
4		29		29	10.4	
5		42		42	15.1	
6		16		16	5.8	
7	Greer Cr.	0		0	0	
8		0		0	0	
9		-		-	-	Sections 9-15
10		-		-	-	were not flown
11		-		-	-	due to
12		-		-	-	restricted pilot
13		-		-	-	time.
14	Nautley R.	-		-	-	
15		-		-	-	
16	Vanderhoof	102		102	36.7	
Total		278		278	100.0	

Appendix 4. (cont'd)

Date and time : September 16, 1986, 1100 - 1600 h

Flying conditions : Sunny/cloudy during survey from Cheslatta Falls to Greer Creek and from km 90 to Vanderhoof; cloudy during survey from Greer Creek to km 90

Viewing conditions: Excellent visibility from Cheslatta Falls to Greer Creek (sections 1-7) and from km 90 to Vanderhoof (sections 14-16); good visibility for Greer Creek to km 90 (sections 8-13)

Section		Count 1[a]	Count 2[a]	Mean Count[a]	% of Total	Comments
1	Cheslatta Falls	44	44	44	2.7	Sections 1-13
2		48	47	48	2.9	flown downstream
3		338	326	332	20.2	from Cheslatta
4		82(2)	76	79(1)	4.8	Falls.
5		52(1)	104	78(1)	4.8	Approx.
6		179	111(9)	145(5)	8.8	370 sockeye
7	Greer Cr.	2	2(1)	2(1)	0.1	observed in
8		32(1)	25	29(1)	1.8	section 5.
9		68	84	76	4.6	
10		98	81(2)	90(1)	5.5	
11		120	89(3)	105(2)	6.4	
12		46	37	42	2.6	
13		2(3)	0	1(1)	0.1	
14	Nautley R.	106(3)	100(4)	103(4)	6.3	Sections 14-16
15		222	232	227	13.8	flown upstream
16	Vanderhoof	245	232	239	14.6	from Vanderhoof.
Total		1684(10)	1590(19)	1640(18)	100.0	

[a] Dead counts are shown in parenthesis.

Appendix 5. Chinook redd counts by section in the Nechako River, 1986.

Date and time : October 10, 1986, 1100 - 1500 h

Flying conditions : Sunny and clear

Viewing conditions: Excellent visibility

Section	Count 1		Count 2		Mean Count		% of
	Redds	x2[a]	Redds	x2[a]	Redds	x2[a]	Redd total
1 Cheslatta Falls	42	84	43	86	43	86	5.2
2	38	76	40	80	39	78	4.7
3	234	468	237	474	236	472	28.5
4	46	92	41	82	44	88	5.3
5	51	102	46	92	49	98	5.9
6	52	104	56	112	54	108	6.5
7 Greer Cr.	0	0	0	0	0	0	0
8[b]	21	42	8	16	15	30	1.8
9	33	66	41	82	37	74	4.5
10	30	60	35	70	33	66	4.0
11	55	110	43	86	49	98	5.9
12	53	106	35	70	44	88	5.3
13	0	0	6	12	3	6	0.4
14 Nautley R.	13	26	21	42	17	34	2.1
15	71	142	45	90	58	116	7.0
16 Vanderhoof	105	210	109	218	107	214	12.9
Total	844	1688	806	1612	828	1656	100.0

[a] One redd is considered to represent one spawning pair.
[b] Redds downstream of Greer Creek were less distinct, particularly below Nautley River at Braeside and Vanderhoof. Number of redds below Nautley was likely underestimated or overestimated.

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1980.

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/11/80	1	1	1	0		3	59.5	4	2		
09/11/80	2		11	1		3	71.5	5	2		
09/11/80	3		21	0		3	74.0	5	2		
09/11/80	4		31	0		3	59.5	5	2		
09/11/80	5		41	1		3	73.0	5	2		
09/14/80	6	2	1	1		3	75.5	5	2		
09/14/80	7		11	1		3	72.5	4	1		
09/14/80	8		21	1		3	69.0	5	2		
09/14/80	9		31	1		3	75.0	5	2		
09/14/80	10		41	1		3	75.5	5	2		
09/14/80	11	3	1	1		3	68.0	4	1		
09/15/80	12	4	1	1		3	71.0	5	2		
09/17/80	13	5	1	1		3	71.0	R*			
09/17/80	14		11	1		3	68.5	5	2		
09/17/80	15		21	1		3	66.0	5	2		
09/17/80	16		31	1		3	62.0	4	2		
09/17/80	17	6	1	0		3	81.0	R			
09/17/80	18		11	1	850	3	59.5	R			
09/18/80	19	7	1	0		3	84.5	5	1		
09/18/80	20		11	0		3	73.0	5	2		
09/18/80	21		21	0		3	76.0	5	2		
09/18/80	22		31	0		3	75.0	5	2		
09/18/80	23		41	0		3	86.0	5	1		
09/18/80	24	8	1	0		3	77.0	5	2		
09/18/80	25		11	1		3	81.0	5	2		
09/18/80	26		21	1	Unspawned	3	77.0	5	2		
09/18/80	27		31	0		3	41.0	3	2		
09/18/80	28		41	1	35	3	68.0	4	1		
09/18/80	29	9	1	1		3	67.0	4	1		
09/18/80	30		11	0		3	80.0	5	2		
09/18/80	31		21	1		3	69.0	5	2		
09/18/80	32		31	1	5	3	74.0	R			
09/18/80	33		41	0		3	77.0	5	2		
09/18/80	34	10	1	0		3	64.0	R			
09/18/80	35		11	1		3	75.0	5	2		
09/18/80	36		21	1	12	3	69.0	5	2		
09/19/80	37	11	1	1		3	69.0	4	1		
09/19/80	38		11	1		3	74.5	4	1		
09/19/80	39		21	1		3	75.0	5	2		
09/19/80	40		31	0		3	86.5	R			
09/19/80	41		41	1	3	3	70.5	5	2		
09/19/80	42	12	1	1	2	3	72.5	5	2		
09/19/80	43		11	1		3	73.5	5	2		
09/19/80	44		21	1	4	3	73.0	5	2		
09/19/80	45		31	0		3	66.5	5	2		
09/19/80	46		41	1		3	67.5	5	2		

* Scales resorbed; not readable

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1980 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/20/80	47	13	1	1		3	71.5	4	1		
09/20/80	48		11	1		3	75.5	4	1		
09/20/80	49		21	1	5000	3	71.0	5	2		
09/20/80	50		31	1		3	71.5	R			
09/20/80	51		41	0		3	79.0	5	2		
09/20/80	52	14	1	1	6	3	79.0	5	2		
09/20/80	53		11	1	1	3	74.0	5	2		
09/21/80	54	15	1	1		3	73.0	5	2		
09/21/80	55		11	1		3	70.0	5	2		
09/21/80	56		21	1	2	3	68.5	4	1		
09/21/80	57		31	1		3	57.0	5	2		
09/21/80	58		41	0		3	70.0	5	2		
09/21/80	59	16	1	1		3	72.5	5	2		
09/21/80	60		11	1		3	75.0	5	2		
09/21/80	61		21	0		3	61.0	5	2		
09/21/80	62		31	0		3	81.5	5	2		
09/21/80	63		41	1	3	3	75.0	5	2		
09/21/80	64	17	1	1	1	3	71.5	5	2		
09/21/80	65		11	0		3	74.0	5	2		
09/21/80	66		21	1		3	75.5	5	2		
09/21/80	67		31	1		3	71.0	5	2		
09/21/80	68		41	1		3	73.0	5	2		
09/21/80	69	18	1	0		3	77.0	4	1		
09/21/80	70		11	1	13	3	72.0	R			
09/21/80	71		21	0		3	72.0	R			
09/21/80	72		31	1	1	3	63.0	4	2		
09/21/80	73		41	0		3	72.0	5	2		
09/21/80	74	19	1	0		3	68.5	4	1		
09/21/80	75		11	0		3	78.5	5	2		
09/21/80	76		21	1	13	3	71.0	5	2		
09/21/80	77		31	0		3	73.0	5	2		
09/21/80	78		41	1	5000	3	71.0	5	2		
09/23/80	79	20	1	0		3	69.0	5	2		
09/23/80	80		11	0		3	76.0	5	2		
09/23/80	81		21	1	10	3	59.0	4	2		
09/23/80	82		31	1		3	72.0	5	2		
09/23/80	83		41	0		3	65.0	4	2		
09/23/80	84	21	1	0		3	82.0	5	2		
09/23/80	85		11	1		3	65.0	5	2		
09/23/80	86		21	1		3	80.0	5	2		
09/23/80	87		31	0		3	82.0	5	2		
09/23/80	88		41	1	36	3	75.0	5	2		
09/23/80	89	22	1	1		3	70.0	5	2		
09/23/80	90		11	0		3	80.0	5	2		
09/23/80	91		21	1	1	3	72.0	5	2		
09/23/80	92		31	1		3	75.0	R			

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1980 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/23/80	93	22	41	1	1	3	71.0	R			
09/25/80	94	23	1	0		3	80.0	5	2		
09/25/80	95		11	0		3	72.0	5	2		
09/25/80	96		21	0		3	81.0	5	2		
09/25/80	97		31	0		3	64.0	R			
09/25/80	98		41	0		3	59.0	4	2		
09/25/80	99	24	1	0		3	82.0	5	2		
09/25/80	100		11	0		3	70.0	5	2		
09/25/80	101		21	0		3	72.0	4	1		
09/25/80	102		31	0		3	50.0	4	2		
09/25/80	103		41	0		3	82.0	R			
09/26/80	104	25	1	1		3	75.0	5	2		
09/26/80	105		11	0		3	68.0	5	2		
09/26/80	106		21	1	4	3	71.0	5	2		
09/26/80	107		31	1	10	3	71.0	5	2		
09/26/80	108		41	1	17	3	70.0	5	2		
09/26/80	109	26	1	1	12	3	75.0	5	2		
09/26/80	110		11	1	1	3	69.0	4	2		
09/26/80	111		21	1	2	3	72.0	5	2		
09/26/80	112		31	1		3	69.0	R			
09/26/80	113		41	1		3	75.0	5	2		
09/26/80	114	27	1	1		3	72.0	5	2		
09/26/80	115		11	0		3	71.0	4	1		
09/26/80	116		21	1		3	69.0	5	2		
09/26/80	117		31	0		3	61.0	4	2		
09/26/80	118		41	1	1	3	75.0	4	1		
09/26/80	119	28	1	1	1	3	74.0	5	2		
09/26/80	120		11	1		3	70.0	4	2		
09/26/80	121		21	1	1	3	73.0	5	2		
09/26/80	122		31	1	1	3	71.0	5	2		
09/26/80	123		41	1	1	3	72.0	5	2		
09/26/80	124	29	1	1	6	3	76.0	5	2		
09/26/80	125		11	0		3	63.0	4	2		
09/26/80	126		21	0		3	74.0	5	2		
09/26/80	127		31	1	1	3	73.0	5	2		
09/26/80	128		41	0		3	82.0	5	2		
09/26/80	129	30	1	0		3	71.0	5	2		
09/26/80	130		11	0		3	73.0	5	2		
09/26/80	131		21	0		3	74.0	5	2		
09/26/80	132		31	1	1	3	67.0	4	2		
09/26/80	133		41	1		3	69.0	5	2		
09/26/80	134	31	1	0		3	72.0	R			
09/26/80	135		11	1	11	3	74.0	5	2		
09/26/80	136		21	1	100	3	76.0	5	2		
09/26/87	137		31	1		3	68.0	5	2		
09/26/87	138		41	0		3	76.0	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1980 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/26/80	139	32	1	0		3	69.0	4	1		
09/26/80	140		11	1		3	75.0	5	2		
09/26/80	141		21	1		3	72.0	5	2		
09/26/80	142		31	0		3	80.0	5	2		
09/26/80	143		41	1		3	71.0	5	2		
09/28/80	144	33	1	1		3	68.0	5	2		
09/28/80	145		11	1	2	3	70.0	4	2		
09/28/80	146		21	1		3	72.0	5	2		
09/28/80	147		31	0		3	66.0	4	2		
09/28/80	148		41	0		3	63.0	R			
09/28/80	149	34	1	1		3	74.0	5	2		
09/28/80	150		11	1	8	3	72.0	5	2		
09/28/80	151		21	1		3	69.0	5	2		
09/28/80	152		31	0		3	75.0	5	2		
09/28/80	153		41	0		3	72.0	R			
09/28/80	154	35	1	1	3	3	61.0	3	1		
09/28/80	155		11	1	25	3	71.0	5	2		
09/28/80	156		21	1		3	71.0	5	2		
09/28/80	157		31	1	1	3	72.0	5	2		
09/28/80	158		41	0		3	68.0	5	2		
09/28/80	159	36	1	0		3	72.0	5	2		
09/28/80	160		11	1	1	3	78.0	5	2		
09/28/80	161		21	1		3	63.0	4	2		
09/28/80	162		31	1		3	75.0	R			
09/28/80	163		41	1	2	3	79.0	5	2		
09/28/80	164	37	1	1		3	70.0	5	2		
09/28/80	165		11	1	4	3	76.0	5	2		
09/28/80	166		21	1	1	3	77.0	5	2		
09/28/80	167		31	1		3	78.0	5	2		
09/28/80	168		41	1	2	3	71.0	5	2		
09/28/80	169	38	1	0		3	82.0	5	2		
09/28/80	170		11	0		3	80.0	5	2		
09/28/80	171		21	1	50	3	62.0	5	2		
09/28/80	172		31	1		3	65.0	R			
09/28/80	173		41	0		3	48.0	4	2		
09/28/80	174	39	1	1		3	69.0	5	2		
09/28/80	175		11	0		3	75.0	4	1		
09/28/80	176		21	1		3	78.0	5	2		
09/28/80	177		31	1		3	72.0	5	2		
09/28/80	178		41	0		3	77.0	4	1		
09/28/80	179	40	1	0		3	62.0	4	2		
09/28/80	180		11	1	1	3	75.0	5	2		
09/28/80	181		21	1		3	73.0	5	2		
09/28/80	182		31	1	1	3	67.0	5	2		
09/28/80	183		41	1	7	3	65.0	4	2		
09/28/80	184	41	1	1	1	3	74.0	4	1		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1980 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/28/80	185		11	1	50	3	75.0	5	2		
09/28/80	186		21	1		3	62.0	4	2		
09/28/80	187		31	1	1	3	77.0	5	2		
09/28/80	188		41	1		3	72.0	5	2		
09/28/80	189	42	1	1	4	3	60.0	4	2		
09/28/80	190		11	0		3	33.0	3	2		
09/28/80	191		21	1	1	3	72.0	5	2		
09/28/80	192		31	1	3	3	74.0	5	2		
09/28/80	193		41	0		3	81.0	5	2		
09/28/80	194	43	1	1	1	3	72.0	4	1		
09/28/80	195		11	0		3	79.0	5	2		
09/28/80	196		21	0		3	63.0	4	2		
09/28/80	197		31	1		3	65.0	5	2		
09/28/80	198		41	1	3	3	76.0	5	2		
09/28/80	199	44	1	0		3	80.0	R			
09/28/80	200		11	1		3	79.0	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1981.

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/22/81	1	2	1	1		3	81.5	5	2		
09/22/81	2		13	1		3	74.0	5	2		
09/22/81	3		24	0		3	80.0	4	1		
09/22/81	4	1	1	1		3	68.0	4	2		
09/22/81	5		13	0		3	82.5	6	2		
09/22/81	6		25	1		3	82.5	5	2		
09/23/81	7	4	1	0		3	79.0	4	1		
09/23/81	8		11	1		3	64.0	4	2		
09/23/81	9		21	0		3	74.0	5	2		
09/23/81	10		31	0		3	80.0	5	2		
09/23/81	11	3	1	1		3	78.5	5	2		
09/23/81	12		11	1		3	70.0	5	2		
09/24/81	13	4	41	1		3	74.0	5	2		
09/25/81	14	6	21	1		3	75.0	5	2		
09/25/81	15		1	0		3	84.0	5	2		
09/25/81	16		31	1		3	70.0	5	2		
09/25/81	17		11	1		3	68.0	4	2		
09/25/81	18		41	0		3	82.0	5	2		
09/25/81	19	8	1	1		3	80.0	5	2		
09/25/81	20		11	0		3	76.0	5	2		
09/25/81	21		21	0		3	78.0	5	2		
09/25/81	22		31	1		3	82.0	4	1		
09/25/81	23		41	1		3	76.0	5	2		
09/25/81	24	10	1	1		3	75.0	5	2		
09/25/81	25		11	1		3	72.0	5	2		
09/25/81	26		21	1		3	77.0	4	1		
09/25/81	27		31	1		3	76.0	5	2		
09/26/81	28		41	1		3	65.0	4	2		
09/26/81	29	5	1	0		3	66.5	4	2		
09/26/81	30		11	0		3	62.0	4	2		
09/26/81	31		21	1		3	60.5	3	1		
09/26/81	32		31	1		3	75.5	5	2		
09/26/81	33		41	0		3	58.0	4	2		
09/26/81	34	7	1	1		3	69.0	5	2		
09/26/81	35		11	0		3	75.0	5	2		
09/26/81	36	12	1	0		3	76.5	5	2		
09/26/81	37		11	0		3	80.0	R*			
09/26/81	38		21	1		3	73.0	5	2		
09/26/81	39		31	0		3	69.5	5	2		
09/26/81	40		41	1		3	69.5	5	2		
09/26/81	41	14	1	0		3	61.5	4	2		
09/26/81	42		11	1		3	72.0	5	2		
09/26/81	43		21	0		3	58.0	4	2		
09/26/81	44		31	1		3	54.0	4	2		
09/26/81	45		41	1		3	69.5	5	2		
09/26/81	46	16	1	1		3	55.0	4	2		

* Scales resorbed; not readable

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1981 (con't).

CARCASS *ECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/26/81	47	16	11	0		3	65.0	5	2		
09/26/81	48	7	21	0		3	67.0	5	2		
09/26/81	49		31	0		3	75.0	5	2		
09/26/81	50		41	1		3	73.0	5	2		
09/26/81	51	9	1	0		3	72.0	R			
09/26/81	52		11	0		3	61.0	4	2		
09/26/81	53		21	0		3	83.0	5	2		
09/26/81	54	16	21	1		3	72.5	5	2		
09/26/81	55		31	1		3	74.0	5	2		
09/26/81	56		41	1		3	68.0	5	2		
09/27/81	57	18	1	1		3	61.0	5	2		
09/27/81	58		21	1		3	75.0	5	2		
09/27/81	59		31	0		3	70.0	5	2		
09/27/81	60		41	0		3	77.0	5	2		
09/27/81	61	20	1	0		3	78.0	5	2		
09/27/81	62		11	1		3	73.0	5	2		
09/27/81	63		21	0		3	67.0	6	2		
09/27/81	64		31	0		3	74.0	5	2		
09/27/81	65		41	0		3	73.0	5	2		
09/27/81	66	22	1	1		3	72.0	5	2		
09/27/81	67		11	1		3	65.0	4	2		
09/27/81	68		21	1		3	71.0	5	2		
09/27/81	69		31	0		3	79.0	5	2		
09/27/81	70		41	1		3	69.0	R			
09/27/81	71	24	1	1		3	52.0	3	2		
09/27/81	72		11	0		3	35.0	4	1		
09/27/81	73		21	0		3	71.0	5	2		
09/27/81	74		31	1		3	69.0	5	2		
09/27/81	75		41	1		3	76.0	5	2		
09/27/81	76	26	1	1		3	72.0	R			
09/27/81	77		11	1		3	64.0	6	2		
09/27/81	78		21	0		3	77.0	5	2		
09/27/81	79		31	1		3	70.0	5	2		
09/27/81	80		41	0		3	80.0	5	2		
09/27/81	81	28	1	1		3	71.0	5	1		
09/27/81	82		11	0		3	82.0	R			
09/27/81	83		21	1		3	48.0	4	2		
09/27/81	84		31	1		3	52.0	4	2		
09/27/81	85		41	0		3	62.0	R			
09/27/81	86	30	1	0		3	64.0	R			
09/27/81	87		11	0		3	72.0	5	2		
09/27/81	88		21	0		3	76.0	5	2		
09/27/81	89		31	0		3	69.0	5	2		
09/27/81	90		41	1		3	68.0	5	2		
09/27/81	91	32	1	0		3	74.0	5	2		
09/27/81	92		11	1		3	63.0	4	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1981 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/27/81	93	32	21	0		3	76.0	5	2		
09/27/81	94		31	0		3	57.0	4	2		
09/27/81	95		41	0		3	77.0	5	2		
09/27/81	96	34	1	1		3	67.0	4	2		
09/27/81	97		11	1		3	55.0	4	2		
09/27/81	98		21	1		3	62.0	4	2		
09/27/81	99		31	1		3	74.0	5	2		
09/27/81	100		41	1		3	62.0	4	2		
09/27/81	101	36	1	1		3	76.0	5	2		
09/27/81	102		11	0		3	56.0	4	2		
09/27/81	103		21	1		3	51.0	4	2		
09/27/81	104	11	1	1		3	71.0	5	2		
09/27/81	105		11	1		3	74.0	5	2		
09/27/81	106		21	1		3	74.0	5	2		
09/27/81	107		31	1		3	65.0	5	2		
09/27/81	108		41	1		3	76.0	5	2		
09/27/81	109	13	1	1		3	62.0	4	2		
09/27/81	110		11	1		3	74.0	5	2		
09/27/81	111		21	1		3	78.0	4	1		
09/28/81	112	15	31	1		3	54.5	R			
09/28/81	113		41	1		3	63.0	4	2		
09/28/81	114	17	1	1		3	74.0	5	2		
09/28/81	115		11	1		3	80.5	5	2		
09/28/81	116		21	1		3	73.5	R			
09/28/81	117		31	0		3	81.5	R			
09/28/81	118		41	1		3	76.0	5	2		
09/28/81	119	19	1	0		3	76.0	5	2		
09/28/81	120		11	1		3	71.0	5	2		
09/28/81	121		21	0		3	76.5	5	2		
09/28/81	122		31	0		3	71.0	5	2		
09/28/81	123		41	1		3	73.5	5	2		
09/28/81	124	21	1	1		3	56.5	4	2		
09/28/81	125	36	31	0		3	70.0	R			
09/28/81	126		41	0		3	74.0	5	2		
09/28/81	127	38	1	0		3	83.0	5	2		
09/28/81	128		11	0		3	75.0	5	2		
09/28/81	129		21	1		3	73.0	5	2		
09/28/81	130	13	31	0		3	77.0	5	2		
09/28/81	131		41	1		3	76.0	5	2		
09/28/81	132	15	1	0		3	65.0	4	2		
09/28/81	133		11	1		3	75.0	5	2		
09/28/81	134		21	1		3	59.0	4	2		
09/28/81	135	42	1	1		3	73.5	5	2		
09/28/81	136		11	1		3	72.5	5	2		
09/28/81	137		21	0		3	58.0	R			
09/28/81	138		31	1		3	69.0	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1981 (con't).

CARCASS *ECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/28/81	139	42	41	0		3	81.0	5	2		
09/28/81	140	44	1	0		3	78.0	5	2		
09/28/81	141	23	1	1		3	45.0	4	2		
09/28/81	142		11	1		3	45.0	4	2		
09/28/81	143		21	0		3	78.5	5	2		
09/28/81	144		31	1		3	65.0	5	2		
09/28/81	145		41	0		3	57.0	R			
09/28/81	146	25	1	1		3	73.0	5	2		
09/28/81	147		11	1		3	70.0	5	2		
09/28/81	148		21	1		3	58.0	4	2		
09/29/81	149	21	11	1		3	71.0	5	2		
09/29/81	150		21	1		3	74.5	5	2		
09/29/81	151		31	1		3	57.0	R			
09/29/81	152	44	11	0		3	71.0	5	2		
09/29/81	153		21	1		3	70.5	5	2		
09/29/81	154		31	1		3	70.5	R			
09/29/81	155		41	0		3	71.5	5	2		
09/29/81	156	40	1	0		3	61.0	4	2		
09/29/81	157		11	1		3	69.0	4	2		
09/29/81	158		21	1		3	64.0	4	2		
09/29/81	159		31	1		3	67.0	4	2		
09/29/81	160		41	1		3	63.5	4	2		
09/29/81	161	46	1	0		3	71.0	5	2		
09/29/81	162		11	0		3	80.0	5	2		
09/29/81	163		21	1		3	68.0	5	2		
09/28/81	164		31	1		3	69.0	5	2		
09/29/81	165		41	1		3	68.0	5	2		
09/30/81	166	25	31	1		3	67.0	5	2		
09/30/81	167		41	1		3	72.5	5	2		
09/30/81	168	21	41	0		3	73.0	5	2		
09/30/81	169	27	1	1		3	75.5	5	2		
09/30/81	170		11	1		3	62.5	4	2		
09/30/81	171		21	0		3	74.0	5	2		
09/30/81	172		31	1		3	70.5	5	2		
09/30/81	173		41	0		3	80.0	5	2		
09/30/81	174	29	1	1		3	72.5	R			
09/30/81	175	48	1	0		3	75.0	5	2		
09/30/81	176	18	41	0		3	65.5	5	2		
09/30/81	177	48	11	1		3	63.0	4	2		
09/30/81	178		21	1		3	45.0	R			
09/30/81	179		31	0		3	84.5	R*			

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1982.

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/11/82	1	1	1	1		3	71.0	5	2		
09/11/82	2		11	0		3	67.0	4	2		
09/12/82	3		21	1		3	74.5	5	2		
09/13/82	4		31	1		3	69.0	5	2		
09/13/82	5		41	0		3	79.5	5	2		
09/13/82	6	2	1	0		3	81.0	5	2		
09/14/82	7		11	1		3	82.5	5	2		
09/14/82	8		21	1		3	69.0	5	2		
09/14/82	9		31	1		3	79.0	5	2		
09/15/82	10		41	1		3	73.0	5	2		
09/15/82	11	3	1	0		3	83.5	6	2		
09/15/82	12		11	1		3	69.0	R			
09/16/82	13		21	0		3	77.0	5	2		
09/16/82	14		31	1		3	69.0	5	2		
09/17/82	15		41	0		3	66.0	5	2		
09/17/82	16	4	1	1		3	72.5	5	2		
09/17/82	17		11	0		3	65.5	5	2		
09/17/82	18		21	0		3	77.5	5	2		
09/17/82	19		31	1		3	69.5	4	2		
09/17/82	20		41	1		3	68.0	R			
09/17/82	21	5	1	0		3	75.0	5	2		
09/17/82	22		11	0		3	77.0	R			
09/17/82	23		21	1		3	69.0	5	2		
09/18/82	24		31	1		3	71.0	5	2		
09/19/82	25		41	1		3	75.0	R			
09/19/82	26	6	1	1		3	78.5	5	2		
09/19/82	27		11	1		3	67.5	5	2		
09/19/82	28		21	0		3	74.0	5	2		
09/19/82	29		31	1		3	69.0	5	2		
09/19/82	30		41	0		3	75.0	5	2		
09/19/82	31	7	1	1		3	66.5	5	2		
09/19/82	32		11	1		3	68.0	5	2		
09/19/82	33		21	0		3	72.5	5	2		
09/19/82	34		31	0		3	72.0	5	2		
09/19/82	35		41	0		3	75.0	R			
09/19/82	36	8	1	0		3	72.0	5	2		
09/19/82	37		11	1		3	70.5	5	2		
09/19/82	38		21	0		3	76.0	5	2		
09/20/82	39		31	0		3	79.5	R			
09/20/82	40		41	0		3	77.0	5	2		
09/20/82	41	9	1	0		3	77.0	5	2		
09/20/82	42		11	1		3	75.5	5	2		
09/20/82	43		21	1		3	74.5	5	2		
09/20/82	44		31	0		3	78.0	5	2		
09/20/82	45		41	1		3	68.0	4	2		
09/20/82	46	10	1	0		3	75.0	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1982 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/20/82	47	10	11	1		3	60.0	R*			
09/20/82	48		21	0		3	69.0	5	2		
09/20/82	49		31	0		3	71.5	5	2		
09/20/82	50		41	0		3	67.5	4	2		
09/21/82	51	11	1	0		3	75.5	5	2		
09/21/82	52		11	1		3	70.0	5	2		
09/21/82	53		21	1		3	71.5	5	2		
09/21/82	54		31	0		3	77.5	5	2		
09/21/82	55		41	1		3	76.5	5	2		
09/21/82	56	12	1	0		3	73.5	5	2		
09/21/82	57		11	1		3	73.0	R			
09/21/82	58		21	0		3	78.5	R			
09/21/82	59		31	0		3	73.5	5	2		
09/21/82	60		41	0		3	81.0	5	2		
09/22/82	61	13	1	0		3	78.0	5	2		
09/22/82	62		11	0		3	80.5	5	2		
09/22/82	63		21	1		3	70.5	5	2		
09/22/82	64		31	1		3	67.0	5	2		
09/22/82	65		41	1		3	75.5	5	2		
09/22/82	66	14	1	1		3	74.0	5	2		
09/22/82	67		11	1		3	71.5	R			
09/22/82	68		21	1		3	77.5	R			
09/22/82	69		31	1		3	73.0	5	2		
09/22/82	70		41	0		3	82.0	6	2		
09/22/82	71	15	1	1		3	71.0	5	2		
09/22/82	72		11	1		3	68.0	5	2		
09/22/82	73		21	1		3	63.0	5	2		
09/22/82	74		31	1		3	63.0	R			
09/22/82	75		41	1		3	74.5	5	2		
09/22/82	76	16	1	0		3	77.0	5	2		
09/22/82	77		11	1		3	70.0	5	2		
09/22/82	78		21	0		3	72.0	5	2		
09/22/82	79		31	0		3	71.0	R			
09/22/82	80		41	0		3	76.0	5	2		
09/22/82	81	17	1	0		3	81.0	5	2		
09/22/82	82		11	1		3	70.0	R			
09/22/82	83		21	1		3	62.0	4	2		
09/22/82	84		31	1		3	75.0	5	2		
09/22/82	85		41	1		3	68.0	5	2		
09/22/82	86	18	1	0		3	67.0	R			
09/22/82	87		11	0		3	77.5	5	2		
09/22/82	88		21	0		3	72.0	5	2		
09/22/82	89		31	1		3	68.5	5	2		
09/22/82	90		41	0		3	81.5	2	2		
09/22/82	91	19	1	0		3	69.0	5	2		
09/22/82	92		11	0		3	80.0	5	2		

* Scales resorbed, not readable

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1982 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/22/82	93	19	21	0		3	73.0	5	2		
09/22/82	94		31	1		3	76.0	5	2		
09/22/82	95		41	0		3	73.5	5	2		
09/22/82	96	20	1	0		3	72.5	5	2		
09/22/82	97		11	1		3	71.0	R			
09/22/82	98		21	0		3	76.5	5	2		
09/22/82	99		31	1		3	80.5	5	2		
09/22/82	100		41	0		3	76.5	5	2		
09/22/82	101	21	1	1		3	66.5	5	2		
09/22/82	102		11	1		3	73.5	5	2		
09/22/82	103		21	0		3	83.0	5	2		
09/22/82	104		31	1		3	76.0	5	2		
09/23/82	105		41	0		3	72.5	5	2		
09/23/82	106	22	1	1		3	57.5	4	2		
09/23/82	107		11	1		3	77.0	5	2		
09/23/82	108		21	0		3	70.0	5	2		
09/23/82	109		31	0		3	77.0	5	2		
09/23/82	110		41	0		3	77.5	5	2		
09/23/82	111	23	1	0		3	79.0	5	2		
09/23/82	112		11	1		3	72.5	5	2		
09/23/82	113		21	0		3	67.5	5	2		
09/23/82	114		31	0		3	78.0	R			
09/23/82	115		41	1		3	63.0	4	2		
09/23/82	116	24	1	0		3	68.0	4	2		
09/23/82	117		11	1		3	73.5	5	2		
09/23/82	118		21	0		3	72.5	5	2		
09/23/82	119		31	0		3	78.0	5	2		
09/23/82	120		41	1		3	73.5	5	2		
09/23/82	121	25	1	1		3	59.5	4	2		
09/23/82	122		11	1		3	72.5	R			
09/23/82	123		21	1		3	73.0	5	2		
09/23/82	124		31	1		3	76.5	5	2		
09/23/82	125		41	1		3	77.0	5	2		
09/23/82	126	26	1	1		3	72.5	5	2		
09/23/82	127		11	0		3	68.0	4	2		
09/23/82	128		21	0		3	74.5	5	2		
09/23/82	129		31	1		3	60.5	4	2		
09/23/82	130		41	0		3	71.5	5	2		
09/23/82	131	27	1	0		3	72.5	5	2		
09/23/82	132		11	1		3	74.0	5	2		
09/23/82	133		21	0		3	73.0	5	2		
09/23/82	134		31	0		3	73.0	5	2		
09/23/82	135		41	1		3	63.0	4	2		
09/23/82	136	28	1	1		3	35.5	4	2		
09/23/82	137		11	1		3	70.5	5	2		
09/23/82	138		21	0		3	81.5	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1982 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/23/82	139	28	31	1		3	62.0	4	2		
09/23/82	140		41	1		3	72.0	R			
09/23/82	141	29	1	1		3	70.5	5	2		
09/23/82	142		11	0		3	78.5	5	2		
09/23/82	143		21	0		3	82.0	5	2		
09/23/82	144		31	0		3	77.0	5	2		
09/23/82	145		41	1		3	72.0	5	2		
09/23/82	146	30	1	1		3	71.5	R			
09/23/82	147		11	0		3	78.5	5	2		
09/23/82	148		21	0		3	72.5	5	2		
09/23/82	149		31	0		3	76.0	5	2		
09/23/82	150		41	1		3	75.5	5	2		
09/23/82	151	31	1	1		3	65.0	4	2		
09/23/82	152		11	0		3	61.0	4	2		
09/23/82	153		21	1		3	69.5	5	2		
09/23/82	154		31	1		3	70.5	5	2		
09/23/82	155		41	1		3	74.5	5	2		
09/23/82	156	32	1	1		3	69.0	5	2		
09/23/82	157		11	0		3	83.0	5	2		
09/23/82	158		21	0		3	73.0	R			
09/23/82	159		31	1		3	66.0	4	2		
09/23/82	160		41	1		3	69.5	5	2		
09/24/82	161	33	1	1		3	66.0	4	2		
09/24/82	162		11	1		3	71.5	5	2		
09/24/82	163		21	1		3	76.5	R			
09/24/82	164		31	1		3	71.0	5	2		
09/24/82	165		41	1		3	71.0	5	2		
09/24/82	166	34	1	0		3	68.5	5	2		
09/24/82	167		11	0		3	76.0	R			
09/24/82	168		21	0		3	77.0	5	2		
09/24/82	169		31	0		3	71.0	5	2		
09/24/82	170		41	0		3	84.0	5	2		
09/24/82	171	35	1	0		3	81.0	5	2		
09/24/82	172		11	0		3	68.0	5	2		
09/24/82	173		21	0		3	58.5	4	2		
09/24/82	174		31	0		3	69.5	5	2		
09/24/82	175		41	1		3	67.0	5	2		
09/24/82	176	36	1	1		3	74.0	5	2		
09/24/82	177		11	1		3	73.0	5	2		
09/24/82	178		21	1		3	67.0	5	2		
09/24/82	179		31	1		3	73.0	5	2		
09/24/82	180		41	0		3	81.0	5	2		
09/24/82	181	37	1	0		3	78.0	5	2		
09/24/82	182		11	0		3	74.5	5	2		
09/24/82	183		21	0		3	74.0	5	2		
09/24/82	184		31	0		3	83.5	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1982 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/24/82	185		41	0		3	80.0	5	2		
09/24/82	186	38	1	0		3	73.0	5	2		
09/24/82	187		11	1		3	72.5	5	2		
09/24/82	188		21	1		3	72.0	5	2		
09/24/82	189		31	1		3	74.5	5	2		
09/24/82	190		41	1		3	72.0	5	2		
09/24/82	191	39	1	1		3	65.5	5	2		
09/24/82	192		11	1		3	63.5	4	2		
09/24/82	193		21	1		3	70.0	5	2		
09/24/82	194		31	0		3	76.0	5	2		
09/24/82	195		41	0		3	82.5	R			
09/24/82	196	40	1	0		3	75.0	5	2		
09/24/82	197		11	0		3	71.0	5	2		
09/24/82	198		21	0		3	72.0	5	2		
09/24/82	199		31	0		3	73.0	5	2		
09/24/82	200		41	0		3	70.0	4	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1984.

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/11/84	1	1	1	0		3	68.0	5	2	5	
	2		11	0		3	62.0	R*		5	
	3		21	1	1	3	77.5	5	2	7	
	4		31	1		3	73.1	5	2	6	
	5		41	1	0	3	63.8	4	2	5	
	6	2	1	1	0	3	61.1	4	2	4	
	7		11	1	9	3	65.9	4	2	4	
	8		21	1	1	3	59.4	4	2	4	
	9		31	1	0	3	68.6	4	1	4	
	10		41	0		3	76.5	4	1		No fin taken
	11	3	1	0		3	61.7	4	2	4	
	12		11	0		16	65.5	5	2	6	
	13		21	1	0	16	84.0	5	2	6	
	14		31	0		16	76.6	5	2	5	
	15		41	1	0	16	75.0	5	2	6	
	16	4	1	0		16	86.8	R		6	
	17		11	1		16	55.0	4	2	4	
	18		21	0		16	72.0	R		5	
	19		31	1	0	16	55.5	4	2	4	
	20		41	1	230	16	62.5	4	2	4	
	21	5	1	1	0	3	56.0	4	2		No fin taken
	22		11	0		3	75.0	5	2	5	
	23		21	0		16	60.1	4	2	4	
	24		31	0		16	84.5	6	2	6	
	25		41	0		16	66.0	5	2	7	
	26	6	1	0		16	81.3	R		6	
	27		11	1	1	16	63.9	R		6	
	28		21	1	1200	16	73.1	6	2	6	
	29		31	0		16	59.1	4	2	4	
	30		41	1	1	16	64.5	4	2	4	
	31	7	1	0		16	61.6	4	2	4	
	32		11	0		16	55.8	4	2	4	
	33		21	1	0	16	60.5	4	2		No fin taken
	34		31	0		16	61.1	4	2	4	
	35		41	0		16	83.2	6	2	6	
	36	8	1	0		16	65.5	4	2	4	
	37		11	0		16	45.2	3	2	3	
	38		21	1	0	16	75.5	5	2	5	
	39		31	0		16	50.5	4	2	4	
	40		41	0		16	62.1	4	2	4	
	41	9	1	1	0	16	71.1	5	2	5	
	42		11	0		16	78.6	5	2	7	
	43		21	0		16	80.5	5	2	5	
	44		31	1	0	16	64.3	4	2	5	
	45		41	1	7	16	58.6	4	2	4	
	46	10	1	1	24	16	66.4	R		5	

* Scales resorbed; not readable

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1984 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
	47	10	11	1	0	16	59.1	4	2	4	
	48		21	0		16	76.6	5	2	6	
	49		31	1	3	16	67.3	4	2	4	
	50		41	0		16	59.0	4	2	4	
	51	11	1	0		16	64.0	4	2	4	
	52		11	0		16	80.0	5	2	5	
	53		21	1	3	16	63.9	4	2	3	
	54		31	0		16	59.2	4	2	4	
	55		41	1	2	16	66.5	4	2	5	
	56	12	1	1	0	16	72.2	R		5	
	57		11	0		16	74.5	R		5	
	58		21	0		16	70.2	R		5	
	59		31	0		16	86.4	9		6	
	60		41	0		16	59.4	R	2	4	
	61	13	1	1	166	16	70.8	5	2	4	
	62		11	0		16	65.0	4	2	4	
	63		21	0		16	57.3	4	2	4	
	64		31	1	8	16	69.3	5	2	5	
	65		41	0		16	65.6	4	2	4	
	66	14	1	1	0	16	50.0	4	2	5	
	67		11	1	6	16	58.4	4	2	5	
	68		21	0		16	47.1	3	2		No fin take
	69		31	0		16	77.1	5	2	6	
	70		41	0		16	69.5	R		4	
	71	15	1	0		16	74.5	5	2	5	
	72		11	1	0	16	72.8	5	2		No fin take
	73		21	0		16	58.1	4	2	4	
	74		31	1	0	16	72.2	5	2	6	
	75		41	1	0	16	60.2	4	2	4	
	76	16	1	1	0	16	73.5	5	2	5	
	77		11	0		16	78.7	5	2	6	
	78		21	1	19	16	75.1	5	2	6	
	79		31	1	15	16	82.2	6	2	8	
	80		41	0		16	62.0	R		5	
	81	17	1	1	1	16	64.6	4	2	4	
	82		11	0		16	62.5	4	2	4	
	83		21	0		16	79.0	5	2	8	
	84		31	0		16	58.0	4	2	4	
	85		41	0		16	61.0	4	2	4	
	86	18	1	0		16	62.7	4	2	4	
	87		11	0		16	81.4	5	2	6	
	88		21	1	1	16	75.6	R		7	
	89		31	0		16	59.0	4	?	5	
	90		41	1	29	16	80.1	R		6	
	91	19	1	0		16	58.5	4	2	4	
	92		11	0		16	76.4	5	2	5	

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1984 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
	93		21	0		16	75.9	5	2	5	
	94		31	1	0	16	63.7	4	2	4	
	95		41	1	5	16	78.4	5	2	5	
	96	20	1	0		16	67.3	4	2	4	
	97		11	0		16	67.9	4	2	4	
	98		21	1	0	3	76.9	R		6	
	99		31	1	0	3	75.7	5	2	5	
	100		41	0		3	70.2	5	2	5	
	101	21	1	1	2	3	66.8	R		5	
	102		11	0		3	57.9	4	2	4	
	103		21	0		3	68.0	R		5	
	104		31	1	6	3	70.6	R		4	
	105	22	1	1	33	16	58.2	4	2	5	
	106		11	0		16	78.3	5	2	7	
	107		21	1	0	16	65.5	4	2	4	
	108		31	1	0	16	61.4	4	2	4	
	109		41	1	0	16	69.7	R	52		
	110	23	1	1	0	16	54.8	4	2	4	
	111		11	1	0	16	73.6	5	2	5	
	112		21	0		16	81.5	R		6	
	113		31	1	5	16	74.9	R		5	
	114		41	1	2	16	71.5	5	2	5	
	115	24	1	1	0	16	59.2	4	2	4	
	116		11	1	11	16	59.8	4	2	4	
	117		21	1	6	16	62.6	4	2	4	
	118		31	1	21	16	63.9	4	2	4	
	119		41	0		16	70.5	4	2	4	
	120	25	1	1	0	16	58.8	4	2	4	
	121		11	1	0	16	58.8	4	2	4	
	122		21	1	0	16	57.2	4	2	4	
	123		31	0		16	46.6	3	2	4	
	124		41	1	2	16	69.8	5	2	5	
	125	26	1	1	0	16	69.3	5	2	5	
	126		11	1	1	16	70.6	5	2	5	
	127		21	1	1	16	69.6	R		5	
	128		31	0		16	68.5	5	2	6	
	129		41	1	0	16	74.3	R		5	
	130	27	1	0		16	79.1	5	2	6	
	131		11	0		16	60.8	4	2	5	
	132		21	0		16	54.5	4	2	4	
	133		31	1	3	16	62.5	4	2	4	
	134		41	1	10	16	69.2	R		4	
	135	28	1	1	0	16	65.9	R		4	
	136		11	1	0	16	78.4	R		6	
	137		21	0		16	64.4	4	2	4	
	138		31	0		16	60.7	4	2	4	

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1984 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
	139	28	41	1	1	16	64.5	4	2	5	
	140	29	1	1	1	16	77.4	R		6	
	141		11	0		16	85.5	R		6	
	142		21	1	0	16	65.5	4	2	4	
	143		31	0		16	61.6	4	2	4	
	144		41	0		16	78.1	5	2	6	
	145	30	1	1	0	16	72.1	4	2	6	
	146		11	0		16	64.2	4	2	4	
	147		21	0		16	73.5	5	2	6	
	148		31	0		16	71.2	5	2	6	
	149		41	1	0	16	66.9	4	2	4	
	150	31	1	0		16	60.0	4	2	4	
	151		11	1	5	16	65.1	4	2	4	
	152		21	1	5	16	64.1	4	2	4	
	153		31	0		16	55.8	4	2	4	
	154		41	1	5	16	65.5	4	2	4	
	155	32	1	1	0	16	74.5	5	2		No fin taken
	156		11	1	2	16	62.5	4	2	4	
	157		21	1	1	16	76.3	R		6	
	158		31	1	0	16	59.0	R		4	
	159		41	1	2	16	60.4	4	2	4	
	160	33	1	1	14	16	73.0	R		5	
	161		11	1	15	16	78.9	5	2	6	
	162		21	0		16	60.1	4	2	4	
	163		31	0		16	75.5	5	2	6	
	164		41	1	5	16	59.6	4	2	5	
	165	34	1	1	3	16	68.8	5	2	4	
	166		11	1	0	16	64.0	4	2	4	
	167		21	1	0	16	62.1	4	2	4	
	168		31	0		16	64.4	4	2	5	
	169		41	1	33	16	60.8	4	2	4	
	170	35	1	1	13	16	71.7	5	2	5	
	171		11	1	45	16	60.7	4	2	4	
	172		21	0		16	86.3	6	2	6	
	173		31	0		16	63.1	4	2	4	
	174		41	1	7	16	62.0	4	2	4	
	175	36	1	1	0	16	61.5	4	2		No fin taken
	176		11	1	1	16	64.8	4	2	5	
	177		21	1	44	16	64.1	4	2	4	
09/28/84	178		31	1	0	16	64.6	4	2	4	

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1985.

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/06/85	1	1	1	0		3	79	5	2		
09/06/85	2		11	1	0	3	70	5	2		
09/09/85	3		21	0		4	84	R			
09/09/85	4		31	0		4	67	4	2		
09/09/85	5		41	0		3	77	5	2		
09/09/85	6	2	1	1	0	3	75	5	2		
09/09/85	7		11	1	250	3	66	4	2		
09/09/85	8		21	1	250	3	68	5	2		
09/10/85	9		31	1	16	3	70	R			
09/10/85	10		41	1	200	3	74	5	2		
09/10/85	11	3	1	0		3	56	4	2		
09/10/85	12		11	0		3	71	R			
09/10/85	13		21	0		3	82	R			
09/10/85	14		31	1	600	4	71	5	2		
09/10/85	15		41	0		4	57	4	2		
09/10/85	16	4	1	0		4	71	R			
09/10/85	17		11	1	4	4	70	5	2		
09/10/85	18		21	1	300	3	74	5	2		
09/10/85	19		31	0		3	66	4	2		
09/10/85	20		41	1	0	3	72	5	2		
09/10/85	21	5	1	1	3	3	67	4	2		
09/12/85	22	101	1	1	400	16	74	R			
09/12/85	23		11	0		16	91	5	2		
09/12/85	24		21	1	0	16	72	R			
09/12/85	25		31	0		16	84	5	2		
09/12/85	26		41	1	550	16	73	5	2		
09/13/85	27	102	1	1	150	16	76	5	2		
09/13/85	28		11	0		16	58	4	2		
09/14/85	29	5	11	0		3	72	R			
09/14/85	30		21	1	0	3	63	4	2		
09/14/85	31		31	1	0	4	70	R			
09/14/85	32		41	0		4	66	4	2		
09/14/85	33	6	1	1	0	4	74	5	2		
09/14/85	34		11	0		4	82	5	2		
09/14/85	35		21	1	14	4	70	4	2		
09/14/85	36		31	0		4	60	4	2		
09/14/85	37		41	0		4	76	5	2		
09/14/85	38	7	1	0		4	61	4	2		
09/14/85	39		11	1	0	4	58	4	2		
09/14/85	40		21	1	425	3	74	5	2		
09/14/85	41		31	0		3	78	5	2		
09/14/85	42		41	0		3	71	R			
09/14/85	43	8	1	1	8	3	75	R			
09/14/85	44		11	0		3	78	5	2		
09/14/85	45		21	0		3	69	R			
09/16/85	46		31	0		3	66	4	2		

* Scales resorbed; not readable

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1985 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/16/85	47	8	41	1	2	4	72	5	2		
09/16/85	48	9	1	1	4	4	62	4	2		
09/16/85	49		11	0		3	72	5	2		
09/16/85	50		21	1	0	3	75	5	2		
09/16/85	51		31	1	0	3	75	5	2		
09/16/85	52		41	1	0	3	70	5	2		
09/16/85	53	10	1	1	0	3	75	5	2		
09/16/85	54		11	0		3	70	R			
09/16/85	55		21	1	1	3	78	5	2		
09/16/85	56		31	1	0	3	77	5	2		
09/16/85	57		41	1	0	3	69	5	2		
09/16/85	58	11	1	1	0	3	77	5	2		
09/16/85	59		11	1	0	3	63	4	2		
09/16/85	60		21	1	40	4	74	5	2		
09/17/85	61		31	1	1	3	63	4	2		
09/17/85	62		41	1	0	3	71	R			
09/17/85	63	12	1	1	0	3	75	R			
09/17/85	64		11	1	6800	3	76	5	2		Live egg tak
09/17/85	65		21	0		3	78	5	2		
09/17/85	66		31	1	0	3	75	5	2		
09/17/85	67		41	1	0	3	62	4	2		
09/17/85	68	13	1	0		3	64	4	2		
09/17/85	69		11	1	15	3	70	5	2		
09/17/85	70		21	1	0	3	66	4	2		
09/17/85	71		31	1	0	3	79	5	2		
09/18/85	72		41	1	0	4	69	R			
09/18/85	73	14	1	0		4	80	5	2		
09/18/85	74		11	1	3	4	78	5	2		
09/18/85	75		21	1	0	4	59	4	2		
09/19/85	76	102	21	1	600	16	80	R			
09/19/85	77		31	1	44	16	58	4	2		
09/19/85	78		41	1	0	16	74	R			
09/19/85	79	103	1	1	3	16	76	5	2		
09/19/85	80		11	0		16	92	5	2		
09/19/85	81		21	1	0	16	82	5	2		
09/19/85	82		31	1	0	16	55	4	2		
09/19/85	83		41	1	0	16	75	5	2		
09/19/85	84	104	1	1	0	16	75	5	2		
09/20/85	85		11	1	90	16	72	5	2		
09/20/85	86		21	1	0	16	70	4	2		
09/20/85	87		31	0		16	72	R			
09/20/85	88		41	0		16	81	5	2		
09/20/85	89	105	1	1	200	16	75	R			
09/20/85	90		11	0		16	68	4	2		
09/20/85	91		21	0		16	78	5	2		
09/20/85	92		31	0		16	80	5	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1985 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/20/85	93		41	1	10	16	80	5	2		
09/20/85	94	106	1	1	0	16	65	4	2		
09/20/85	95		11	0		16	65	4	2		
09/20/85	96		21	0		16	80	5	2		
09/20/85	97		31	0		16	80	R			
09/20/85	98		41	0		16	79	5	2		
09/20/85	99	107	1	0		16	76	5	2		
09/20/85	100		11	1	0	16	72	5	2		
09/21/85	101	14	31	1	6	3	76	5	2		
09/21/85	102		41	1	105	3	77	5	2		
09/21/85	103	15	1	1	0	3	79	5	2		
09/21/85	104		11	1	1	3	80	R			
09/21/85	105		21	0		3	82	5	2		
09/21/85	106		31	1	0	3	80	5	2		
09/21/85	107		41	1	2	3	68	R			
09/21/85	108	16	1	1	0	3	61	4	2		
09/21/85	109		11	0		3	70	4	2		
09/23/85	110		21	0		3	74	R			
09/23/85	111		31	1	0	3	76	5	2		
09/23/85	112		41	1	0	3	69	5	2		
09/23/85	113	17	1	1	42	3	69	R			
09/23/85	114		11	0		3	61	R			
09/23/85	115		21	1	3	3	79	5	2		
09/24/85	116		31	1	0	3	71	R			
09/24/85	117	18	11	0		3	75	R			
09/24/85	118		21	0		4	53	4	2		
09/24/85	119		31	1	3	4	75	5	2		
09/24/85	120		41	1	3	4	71	5	2		
09/24/85	121	19	1	1	0	5	67	5	2		
09/24/85	122		21	1	7	5	65	R			
09/24/85	123		31	0		7	64	4	2		
09/25/85	124	201	1	1	6	9	75	5	2		
09/25/85	125		11	1	8	10	83	5	2		
09/25/85	126		21	1	0	10	75	R			
09/25/85	127		31	1	21	11	71	5	2		
09/25/85	128		41	1	0	13	74	5	2		
09/26/85	129	108	1	1	1	16	74	5	2		
09/26/85	130		11	1	1	16	75	5	2		
09/26/85	131		21	1	8	16	71	5	2		
09/26/85	132		31	1	0	16	73	5	2		
09/26/85	133		41	0		16	78	5	2		
09/26/85	134	109	1	1	1	16	78	5	2		
09/26/85	135		11	1	1	16	70	5	2		
09/26/85	136		21	1	0	16	62	4	1		
09/26/85	137		31	1	5	16	69	5	2		
09/26/85	138		41	1	0	16	58	R			

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1985 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/26/85	139	110	1	0		16	82	5	2		
09/26/85	140		11	1	4	16	75	5	2		
09/26/85	141		21	0		16	65	4	2		
09/26/85	142		31	1	10	16	74	5	2		
09/26/85	143		41	0		16	59	4	2		
09/27/85	144	111	1	1	1	16	79	5	2		
09/27/85	145		11	0		16	72	5	2		
09/27/85	146		21	1	8	16	69	R			
09/27/85	147		31	0		16	73	5	2		
09/27/85	148		41	1	0	16	63	5	2		
09/27/85	149	112	1	1	0	16	62	4	2		
09/27/85	150		11	0		16	75	R			
09/27/85	151		21	1	1	16	66	4	2		
09/27/85	152		31	0		16	81	5	2		
09/27/85	153		41	0		16	78	5	2		
09/27/85	154	113	1	1	2	16	74	5	2		
09/27/85	155		11	1	3	16	77	R			
09/27/85	156		21	0		16	79	5	2		
09/27/85	157		31	0		16	79	5	2		
09/28/85	158		41	1	13	16	65	4	2		
09/28/85	159	114	1	1	41	16	77	R			
09/28/85	160		11	0		16	56	4	2		
09/28/85	161		21	1	0	16	69	5	2		
09/28/85	162		31	0		16	74	R			
09/28/85	163		41	1	0	16	72	5	2		
09/28/85	164	115	1	1	2	16	63	4	2		
09/28/85	165		11	1	1	16	77	5	2		
09/28/85	166		21	1	1	16	73	R			
09/28/85	167		31	1	0	16	80	5	2		
09/28/85	168		41	1	0	16	74	5	2		
09/28/85	169	116	1	0		16	84	R			
09/28/85	170		11	1	1	16	75	5	2		
09/28/85	171		21	1	5	16	71	5	2		
09/28/85	172		31	1	0	16	69	5	2		
09/28/85	173		41	1	10	16	71	R			
09/28/85	174	117	1	1	0	16	73	R			
09/28/85	175		11	0		16	70	4	2		
09/28/85	176		21	1	0	16	71	R			
09/28/85	177		31	1	0	16	79	5	2		
09/28/85	178		41	1	0	16	73	R			
09/28/85	179	118	1	1	6	16	62	4	2		
09/30/85	180	202	1	1	2	12	76	5	2		
09/30/85	181		11	1	0	12	73	5	2		
09/30/85	182		21	1	0	12	78	5	2		
09/30/85	183		31	0		11	85	5	2		
09/30/85	184		41	1	0	11	58	4	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1986.

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/12/86	1	1	1	1	0	4	57.5	4	2		
09/12/86	2		11	0		3	72.0	R*			
09/15/86	3		21	1	0	3	68.5	4	2		
09/15/86	4		31	1	0	3	70.0	R			
09/15/86	5		41	1	0	4	69.5	5	2		
09/18/86	6	2	1	1	7	3	72.0	R			
09/19/86	7		11	0		3	75.5	5	2		
09/19/86	8		21	1	200	4	78.0	6	2		
09/19/86	9		31	1	0	4	60.0	4	2		
09/19/86	10		41	1	0	5	71.0	5	2		
09/19/86	11	3	1	0		4	62.0	4	2		
09/19/86	12		11	1	0	3	71.0	5	2		
09/19/86	13		21	1	0	4	61.0	4	2		
09/19/86	14		31	0		3	81.0	5	2		
09/19/86	15		41	1	0	3	69.0	R			
09/19/86	16	4	1	0		3	80.0	5	2		
09/20/86	17		11	1	35	4	58.0	4	2		
09/20/86	18		21	1	0	4	72.0	5	2		
09/20/86	19		31	0		7	81.0	5	2		
09/20/86	20		41	1	0	7	57.0	4	2		
09/20/86	21	5	1	0		5	65.0	4	2		
09/20/86	22		11	0		4	72.0	5	2		
09/20/86	23		21	1	0	3	57.0	4	2		
09/20/86	24		31	0		3	79.0	5	2		
09/20/86	25		41	0		3	77.0	5	2		
09/20/86	26	6	1	0		3	75.0	5	2		
09/20/86	27		11	0		3	67.5	R			
09/20/86	28		21	1	30	4	63.5	4	2		
09/20/86	29		31	1	300	4	59.0	5	2		
09/20/86	30		41	1	7	4	71.0	5	2		
09/20/86	31	7	1	1	0	3	55.5	4	2		
09/20/86	32		11	0		4	49.0	3	2		
09/20/86	33		21	1	1600	3	73.0	5	2		
09/21/86	34		31	1	0	4	74.5	R			
09/21/86	35		41	0		3	67.0	4	2		
09/21/86	36	8	1	1	0	3	57.5	4	2		
09/21/86	37		11	0		3	78.5	R			
09/21/86	38		21	1	0	3	60.0	R			
09/21/86	39		31	1	600	3	66.5	5	2		
09/21/86	40		41	0		3	74.5	5	2		
09/22/86	41	9	1	0		15	85.5	R			
09/22/86	42		11	1	0	15	59.5	4	2		
09/22/86	43		21	0		15	71.0	R			
09/22/86	44		31	1	0	15	74.5	5	2		
09/22/86	45		41	0		15	73.5	5	2		
09/22/86	46	10	1	1	0	16	66.0	R			

* Scales resorbed; not readable

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1986 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/22/86	47	10	11	0		16	61.0	4	2		
09/22/86	48		21	0		16	78.0	5	2		
09/22/86	49		31	1	0	16	67.0	4	2		
09/23/86	50		41	1	0	3	58.5	4	2		
09/23/86	51	11	1	1	0	3	57.5	4	2		
09/23/86	52		11	0		3	81.5	6	2		
09/23/86	53		21	0		3	80.0	6	2		
09/23/86	54		31	0		3	76.0	R			
09/23/86	55		41	0		3	85.0	R			
09/23/86	56	12	1	0		3	77.0	5	2		
09/23/86	57		11	0		3	81.0	R			
09/23/86	58		21	0		3	78.5	5	2		
09/24/86	59		31	0		6	72.5	R			
09/24/86	60		41	0		6	85.7	5	2		
09/24/86	61	13	1	0		6	70.4	5	2		
09/24/86	62		11	0		6	72.0	R			
09/24/86	63		21	0		4	77.0	R			
09/24/86	64		31	1	0	4	57.5	4	2		
09/24/86	65		41	0		3	60.3	4	2		
09/24/86	66	14	1	1	4	3	63.5	4	2		
09/24/86	67		11	0		3	74.7	R			
09/24/86	68		21	1	0	3	69.0	5	2		
09/24/86	69		31	0		7	83.5	6	2		
09/24/86	70		41	1	0	7	71.2	R			
09/24/86	71	15	1	0		7	75.4	R			
09/24/86	72		11	0		7	76.1	5	2		
09/24/86	73		21	1	3	7	69.5	R			
09/24/86	74		31	1	12	7	74.7	R			
09/24/86	75		41	1	7	7	71.2	5	2		
09/24/86	76	16	1	1	0	6	73.1	5	2		
09/24/86	77		11	1	9	6	71.8	R			
09/24/86	78		21	1	3	6	57.7	4	2		
09/24/86	79		31	1	0	6	57.7	4	2		
09/24/86	80		41	1	0	6	73.9	5	2		
09/24/86	81	17	1	1	0	6	73.0	5	2		
09/24/86	82		11	1	0	6	67.6	5	2		
09/24/86	83		21	0		6	80.0	5	2		
09/24/86	84		31	0		6	74.0	R			
09/24/86	85		41	0		6	78.0	5	2		
09/24/86	86	18	1	1	0	3	72.2	R			
09/24/86	87		11	1	0	3	69.5	5	2		
09/24/86	88		21	0		3	70.0	R			
09/24/86	89		31	0		3	77.1	5	2		
09/25/86	90		41	1	67	6	67.8	5	2		
09/25/86	91	19	1	1	9	6	68.4	R			
09/25/86	92		11	1	3	6	59.8	4	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1986 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
09/25/86	93	19	21	1	3	3	67.5	5	2		
09/25/86	94		31	0		3	60.6	4	2		
09/25/86	95		41	1	27	3	74.3	5	2		
09/25/86	96	20	1	1	0	3	69.7	R			
09/25/86	97		11	0		7	58.8	4	2		
09/25/86	98		21	1	0	7	67.3	R			
09/25/86	99		31	0		7	80.2	6	2		
09/25/86	100		41	1	15	4	72.0	5	2		
09/25/86	101	21	1	1	0	4	66.8	5	2		
09/25/86	102		11	0		6	73.5	5	2		
09/25/86	103		21	1	0	6	68.8	R			
09/25/86	104		31	0		6	75.1	5	2		
09/25/86	105		41	1	0	4	63.6	4	2		
09/25/86	106	22	1	0		3	72.9	5	2		
09/25/86	107		11	0		3	65.9	R			
09/25/86	108		21	0		3	76.7	5	2		
09/25/86	109		31	1	0	3	75.6	5	2		
09/25/86	110		41	1	0	3	61.8	4	2		
09/25/86	111	23	1	1	0	3	70.5	R			
09/25/86	112		11	0		3	74.5	R			
09/30/86	113		21	1	0	3	72.5	5	2		
09/30/86	114		31	0		3	86.0	5	2		
09/30/86	115		41	1	0	3	69.9	R			
09/30/86	116	24	1	0		4	76.5	5	2		
09/30/86	117		11	1	0	4	57.2	R			
09/30/86	118		21	0		4	80.5	R			
09/30/86	119		31	0		4	73.9	R			
09/30/86	120		41	1	0	4	70.6	5	2		
09/30/86	121	25	1	0		5	71.0	5	2		
09/30/86	122		11	1	4	5	71.0	5	2		
09/30/86	123		21	1	18	5	76.0	5	2		
09/30/86	124		31	1	0	5	64.8	R			
09/30/86	125		41	1	0	5	71.6	R			
09/30/86	126	26	1	0		5	79.0	5	2		
09/30/86	127		11	1	0	5	71.0	R			
09/30/86	128		21	0		6	71.0	R			
09/30/86	129		31	1	0	6	64.6	5	2		
09/30/86	130		41	1	0	6	68.2	5	2		
09/30/86	131	27	1	0		6	76.6	5	2		
09/30/86	132		11	1	0	6	74.6	5	2		
09/30/86	133		21	1	25	6	74.2	5	2		
09/30/86	134		31	1	28	6	76.5	6	2		
09/30/86	135		41	1	4	6	76.0	R			
09/30/86	136	28	1	1	0	7	73.4	5	2		
09/30/86	137		11	1	0	7	62.2	4	2		
09/30/86	138		21	1	0	7	61.3	4	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1986 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENT
09/30/86	139		31	1	0	7	78.3	5	2		
09/30/86	140		41	1	0	7	67.1	R			
09/30/86	141	29	1	1	0	7	70.5	R			
09/30/86	142		11	1	0	7	70.5	5	2		
09/30/86	143		21	0		7	90.0	R			
09/30/86	144		31	0		7	76.5	R			
09/30/86	145		41	1	0	7	72.1	R			
09/30/86	146	30	1	1	0	7	66.5	R			
09/30/86	147		11	0		7	77.5	R			
09/30/86	148		21	1	0	7	73.6	5	2		
09/30/86	149		31	1	34	7	71.0	5	2		
09/30/86	150		41	1	0	7	77.5	5	2		
09/30/86	151	31	1	0		7	77.8	5	2		
09/30/86	152		11	0		7	77.5	R			
09/30/86	153		21	1	0	3	65.0	4	2		
09/30/86	154		31	1	0	3	60.0	5	2		
09/30/86	155		41	0		4	71.0	4	2		
10/01/86	156	32	1	1	2	15	62.2	4	2		
10/01/86	157		11	1	60	15	63.1	4	2		
10/01/86	158		21	1	5	15	72.2	5	2		
10/01/86	159		31	1	2	15	68.2	5	2		
10/01/86	160		41	1	0	15	68.4	5	2		
10/01/86	161	33	1	1	0	15	69.5	5	2		
10/01/86	162		11	1	8	15	73.1	5	2		
10/01/86	163		21	1	0	15	69.9	R			
10/01/86	164		31	1	0	15	65.4	4	2		
10/01/86	165		41	1	0	15	72.6	5	2		
10/01/86	166	34	1	1	0	15	76.0	5	2		
10/01/86	167		11	1	3	15	70.7	R			
10/01/86	168		21	1	8	15	68.0	4	2		
10/01/86	169		31	1	0	15	77.1	5	2		
10/01/86	170		41	1	0	15	62.7	4	2		
10/01/86	171	35	1	0		15	71.4	R			
10/01/86	172		11	0		15	72.0	5	2		
10/01/86	173		21	0		15	65.8	4	2		
10/01/86	174		31	0		15	80.5	5	2		
10/01/86	175		41	0		15	65.0	4	2		
10/01/86	176	36	1	0		15	75.2	R			
10/01/86	177		11	0		15	81.2	5	2		
10/01/86	178		21	0		15	73.8	R			
10/01/86	179		31	0		16	79.9	5	2		
10/01/86	180		41	0		16	80.2	5	2		
10/01/86	181	37	1	0		16	79.9	5	2		
10/01/86	182		11	0		16	74.1	R			
10/01/86	183		21	0		16	83.2	R			
10/01/86	184		31	0		16	68.4	4	2		

Appendix 6. Nechako River Chinook Carcass Recovery Program, Raw Data, 1986 (con't).

CARCASS RECOVERED MO/DY/YR	FISH #	BOOK #	SCALE #'s	SEX M=0,F=1	EGG RETENTION	REACH RECOVERED	POHL (cm)	SCALES TOTAL (yrs)	SCALES FRESH (yrs)	FIN RAYS TOTAL (yrs)	COMMENTS
10/01/86	185		41	0		16	80.9	5	2		
10/01/86	186	38	1	0		16	79.3	5	2		
10/01/86	187		11	0		13	76.0	R			
10/02/86	188		21	0		13	80.2	5	2		
10/02/86	189		31	0		13	75.0	5	2		
10/01/86	190		41	0		13	74.8	5	2		
10/02/86	191	39	1	0		16	68.0	R			Below Vanderhoof
10/02/86	192		11	0		16	82.0	5	2		Below Vanderhoof
10/02/86	193		21	0		16	56.3	3	2		Below Vanderhoof
10/02/86	194		31	0		16	74.0	5	2		Below Vanderhoof
10/02/86	195		41	0		16	57.2	4	2		Below Vanderhoof
10/02/86	196	40	1	0		16	82.2	5	2		Below Vanderhoof
10/02/86	197		11	0		16	68.4	R			Below Vanderhoof
10/02/86	198		21	0		16	81.9	R			Below Vanderhoof
10/02/86	199		31	0		16	76.7	R			Below Vanderhoof
10/02/86	200		41	0		16	79.8	5	2		Below Vanderhoof
10/02/86	201	41	1	0		16	70.1	R			Below Vanderhoof
10/02/86	202		11	0		16	78.3	5	2		Below Vanderhoof
10/02/86	203		21	0		16	69.0	R			Below Vanderhoof
10/02/86	204		31	0		16	71.0	R			Below Vanderhoof
10/02/86	205		41	0		16	76.8	R			Below Vanderhoof

Appendix 7. Mean September spawning flows[1] in the Nechako River, 1930-1986.

Year	Monthly flow m^3/s	cfs	Year	Monthly flow m^3/s	cfs
1930	155	5472	1959	352	12426
1931	141	4977	1960	262	9249
1932	202	7131	1961	483	17050
1933	158	5577	1962	228	8048
1934	186	6566	1963	194	6848
1935	144	5083	1964	195	6884
1936	139	4907	1965	174	6142
1937	180	6354	1966	291	10272
1938	147	5189	1967	139	4907
1939	173	6107	1968	223	7872
1940	183	6460	1969	158	5577
1941	140	4942	1970	111	3918
1942	124	4377	1971	176	6213
1943	137	4836	1972	233	8225
1944	128	4518	1973	42.2	1490
1945	119	4201	1974	27.8	981
1946	132	4660	1975	118	4165
1947	133	4695	1976	282	9955
1948	206	7272	1977	76.9	2715
1949	166	5860	1978	34.2	1207
1950	151	5330	1979	37.0	1306
1951	117	4130	1980	36.2	1278
1952	141	4977	1981	42.3	1493
1953	17.1	604	1982	35.8	1264
1954	28.1	992	1983	34.9	1232
1955	8.1	286	1984	35.5	1253
1956	9.7	342	1985	64.4	2273
1957	147	5189	1986	32.6±	1151±
1958	306	10802			

[1] Sources of data:

1930-1952 Nechako River at Fort Fraser (Station 08JA001)
1953-1956 Nechako at Vanderhoof minus Nautley (Station 08JC001-08JB003)
1957-1979 Alcan EIS (1984), Volume 2
1980-1986 Nechako below Cheslatta Falls (Station 08JA017)

Discrepancies between m^3/s and cfs are due to rounding error.

Appendix 8. Fishery Officer escapement estimates and comments, 1934-1986[1].

	Fishery Officer Letter Score[2]	Fishery Officer Numerical Estimate	Comments[3] on extent of survey, conditions and spawner distribution
1934	100-300 (P)[4]		Upper Nechako River only.
1935	1000-2000 (P)		Upper Nechako River only.
1936	500-1000		40 miles upstream of Fort Fraser and vicinity of Vanderhoof.
1937	2000-5000		Total count.
1938	500-1000 (P)		Upper Nechako River above Fort Fraser only.
1939	1000-2000		Large number in vicinity of Vanderhoof.
1940	2000-5000	3000	Distribution 5-45 miles above Fort Fraser and 1-6 miles upstream of Vanderhoof.
1941	1000-2000 (P)		Main spawning grounds 60 miles upstream of Fort Fraser not visited. None observed in Vanderhoof area.
1942	300-500		
1943	100-300 (P)		River above Fort Fraser not visited during spawning.
1944	100-300 (P)		Upper spawning areas not visited; trapper reports only. A few chinook spawned in the area 1-6 miles above Vanderhoof.
1945	500-1000 (P)	1200-1300	Upper spawning areas not visited; trapper reports only. 200-300 spawners 1-6 miles above Vanderhoof.
1946	500-1000 (P)	1000	Upper spawning areas not visited; trapper reports only. A few chinook spawned 1-6 miles above Vanderhoof.
1947	No estimate		Not patrolled.
1948	No estimate		Spawning areas were well populated.
1949	2000-5000	3000[5]	Nechako River was surveyed by boat from Fort Fraser to Cheslatta during spawning. (McLaren, 1951)
1950	1000-2000	1500[5]	
1951	2000-5000	2000-3000[5]	Slightly turbid water due to dam construction.[5]
1952	2000-5000	3800[5]	Kenney Dam closure in October.
1953	300-500	400+	Count of 400+ chinook through the weir at Fort Fraser.
1954	1000-2000		
1955	300-500		
1956	100-300		Poor survival of the 1952 brood.
1957	No estimate		Visual observations impossible due to silting.
1958	No estimate		Water high and silty; chinook entered Nautley River and Stellako River. No live or dead fish observed in upper Nechako in early October.
1959	No estimate		Water high and silty; chinook spawned in the Stellako.
1960	50-100		Water clearing at lower discharges.
1961	300-500	300-400	Decreasing silt load. Chinook returning to spawning areas. Extremely high water at spawning. Estimate based on redd count on Oct. 23 to Oct. 24. Count was 170-200 redds and 62 carcasses upstream of Greer Creek (letter from J.P. Tuyttens to A.L. Murray, Oct. 30, 1961)
1962	300-500		Water is becoming clearer and chinook returning to areas noted in 1949-1952.

Appendix 8 (Cont'd)

	Fishery Officer Letter Score[2]	Fishery Officer Numerical Estimate	Comments[3] on extent of survey, condition and spawner distribution
1963	300-500	400+[5]	Relatively good visibility.
1964	500-1000	600-800	
1965	300-500		First year since 1957 that spawning count was at peak.
1966	300-500	400-500	
1967	500-1000	500-600[5]	More chinook returning as river clears.
1968	300-500		High water.
1969	300-500		
1970	500-1000		
1971	300-500		
1972	300-500		Unpublished data indicates that a redd count was conducted above Fort Fraser on Nov. 15 (by boat) with habitat staff (R. Elvidge) and yielded about 200 redds on 400 spawners.
1973	500-1000		
1974	500-1000	700-800	Change in spawning distribution; more chinook spawned in vicinity of Vanderhoof and Engen.
1975	1000-2000	1400	Fishermen's strike. Spawning peak from Sept. 18-25. 1,000 chinook above Fort Fraser and 400 at Engen and Vanderhoof.
1976	1000-2000	1200	Enumeration difficult due to high water.
1977	2000-5000	2000+	2,000 between Fort Fraser and Cheslatta on Sept. 20.
1978	2000-5000	2600 3000[5]	Spawner distribution in Upper Nechako (Greer to Cheslatta), Engen area and 4 miles above Vanderhoof. Flights on Sept. 12 and Sept. 20.[5]
1979	1000-2000	1800	Distribution as above.
1980	1000-2000	1600	1,200 from Cheslatta to Greer; 400 from Greer to Vanderhoof.
1981	500-1000	500	Heavy silt load and peak spawning missed. Number could be underestimated 4-5 times.
1982	1300	1300	Good visibility on September 14; actual count 975 fish.
1983	500-1000	800-900	Count was past peak; actual count of 475 fish; change in spawning distribution noted with more fish in lower river.
1984	1300		Helicopter flights on Sept 14 (fair visibility) and Sept 13 (good visibility). Live counts 308 and 1,287 respectively. Observed many redds from previous years not used.
1985	2000		4 helicopter flights by Habitat staff.
1986	2000		4 helicopter flights by Habitat staff.

[1] Annual reports of salmon stream and spawning grounds (B.C. 16).

[2] Fishery Officer letter scores: A 1-50, B 50-100, C 100-300, D 300-500, E 500-1000, F 1000-2000, G 1000-5000

[3] No comments does not necessarily imply a total count or good conditions.

[4] Partial count.

[5] Annual narrative reports by the Fishery Officer.

Appendix 9. Chinook observations reported in annual reports by Alcan.

Year	Reference[1]	Summary of observations
1952	Coles, 1953[2]	Accurate live count extremely difficult due to size of river or depth of spawning to 4-5 feet. Closure of Kenney Dam was on October 8. Redd count conducted on October 14 and 4,000 spawners were estimated in the upper Nechako River (above Nautley) (which agreed with the Department's estimate).
1953	McKone, 1956[2]	296 redds counted in the upper Nechako River, 132 redds in vicinity of Engen and 103 above Vanderhoof. 424 spawners counted through the Fisheries weir at Fort Fraser.
1954	McKone, 1956[2]	457 redds counted inthe upper Nechako River and 65 redds in middle Nechako River (Engen and Vanderhoof).
1955	McKone, 1956[2]	180 redds counted in the upper Nechako River on September 19 and 213 redds in the middle river on October 18.
1956	McKone, 1957[2]	20 chinook were observed on September 10 and 11 in the upper Nechako River. 56 redds were counted on October 16 in the upper river and 108 redds were counted in the middle river.
1957	Estabrooks, 1958	No counts possible due to high murky water.
1958	Estabrooks, 1959	No counts possible due to high murky water; one trip from Cheslatta to Nautley on October 4 yielded no chinook. Estimated 3,478 chinook spawned in the Stellako River.
1959	Estabrooks, 1960	High discharge made visibility impossible. 709 chinook in the Stellako River on September 11.
1960	Estabrooks, 1961	No chinook observed in the Upper Nechako River. 185 chinook in the Stellako River on September 11.
1961	Estabrooks, 1961	No surveys of the upper Nechako River due to high discharge. 88 chinook in the Stellako River on September 21.
1962	Estabrooks, 1963	No inspections of the upper Nechako River during spawning due to high discharge. No redds were observed in December with the exception of a possible 10-12 upstream of Greer Creek. 176 chinook in the Stellako River on September 15.

Appendix 9 (Cont'd)

	Reference	Summary of observations
1963	Estabrooks, 1964	No estimate given for the upper Nechako River because of the depth, width and restricted visibility of the river. 4 chinook observed on September 24 and 2 redds in December. 738 chinook in the Stellako River.
1964	Estabrooks, 1965	14 dead chinook observed on September 29; no survey in December. 173 chinook in the Stellako.
1965	Estabrooks, 1966	63 dead chinook observed on October 14; 47 above Greer Creek. 86 chinook in the Stellako River.
1966	Estabrooks, 1967	Due to high flows in the Nechako River, it was impossible to determine whether or not chinook spawned in the area. 77 chinook in the Stellako River.
1967	Estabrooks, 1968	30 chinook redds in the upper Nechako River in early October. 40 chinook in the Stellako River.
1968	Estabrooks, 1969	40 dead chinook in the upper Nechako River on October 9. 35 chinook in the Stellako River.
1969	Estabrooks, 1970	25 dead chinook in the upper Nechako River on October 4. 30 chinook in the Stellako River.
1970	Estabrooks, 1971	Cutoff Creek to Fort Fraser surveyed; 55 redds identified mostly above Greer Creek. 100 chinook in the Stellako River.
1971	Estabrooks, 1972	Cutoff Creek to Fort Fraser surveyed; redds observed. 50 chinook in the Stellako River.
1972	Estabrooks, 1974	Upper Nechako River inspected on September 28 but due to high flows could not determine whether or not chinook spawned in the area. 40 chinook in the Stellako River.
1973	Estabrooks, 1975	Cutoff Creek to Greer Creek inspected; 60 chinook observed in mid September. 40 chinook in Stellako River.
1974	Estabrooks, 1975	5 miles upstream of Cutoff Creek to Greer Creek inspected; 270 chinook observed on September 11.
1975	Estabrooks, 1976	45 dead chinook and 7 live chinook observed in upper Nechako in late September. 20 chinook in Stellako River.

Appendix 9 (Cont'd)

	Reference	Summary of observations
1976	Estabrooks, 1978	18 chinook observed on main spawning ground in upper Nechako River on September 10. High flows made observations difficult. 14 chinook in Stellako River.
1977	Estabrooks, 19	15 live chinook and 60 dead chinook observed on September 25.
1978[3]	Estabrooks, 1980	Chinook spawned from Cheslatta Falls to Greer Creek; total escapement estimated to be 2,300 based on redd count on October 3 (3 helicopter trips).
1979[3]	Estabrooks, 1980	Total escapement estimated to be 2,100 based on redd count on October 15. Spawning occurred to Greer Creek but the majority in the upper 8 miles below Cheslatta.
1980[3]	Farina, 1982	Helicopter survey on September 5, 12 and 20 yielded 610, 1,292 and 1,480 chinook respectively. Redd count on October 21 was 795 or an estimated 1,590 spawners above Greer Creek.
1981[3]	Farina, 1982	Count was not possible due to high and muddy water. Redd count on October 22 totalled 768 redds or 1,540 spawners in the upper 16 miles of the Nechako River.
1982[3]	Farina, 1983	830 chinook observed on September 17 in the upper river and 464 chinook were observed on September 25. 670 redds were counted in the upper 26 km section of the Nechako River and 54 redds in the 32 km section below Greer Creek (October 3).
1983[3]	Farina, 1984	250 chinook and 111 chinook observed on September 18 and September 26 respectively. 110 redds counted from Cheslatta to Greer Creek and 22 redds in the 32 km section below Greer Creek (October 12). September 18 was considered the "approximate peak of spawning".
1984[3]		338 redds counted from Cheslatta to Greer Creek on October 3.
1985	Farina, 1986	309 redds counted from Cheslatta to Greer Creek on Sept. 30. Majority of redds were in the Section between Bert Irvine's and River Ranch.

[1] Annual reports entitled "A Study of Salmon Migration and Spawning in the Nechako River System". Alcan Smelters and Chemicals, Limited. B.C. Operations, Kitimat.
[2] Data presented in Table 8.
[3] Data presented in Table 10.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1974[1]

Date	Section	Location						Total	
		Upper Nechako 1-7		Mid Nechako 8-13		Lower Nechako 14-16			
		Spawners	Redds (X2)	Spawners	Redds (X2)	Spawners	Redds (X2)	Spawners	Redds (X2)
Sept	11[2]	132	126	10	2	NS[3]		142	128
	13[2]	159[3]				NS		159	
	16	117		33		184		334	
	16[2]	216	346	NS		NS		216	346
	18	325	428	NS		NS		325	428
	20[2]	229	502	35	68	NS		264	570
	23	267	668	49	88	NS		316	756
Oct	1	37	816	4	120	15	488	56	1424

[1] Source: Department of Fisheries and the Environment (1979) Volume 3 Appendix I and Table 2.

[2] Boat surveys, all others were helicopter surveys.

[3] NS - not surveyed.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1978[1]

Date	Section	Location					Total
		Upper Nechako 1-7		Mid Nechako 8-13	Lower Nechako 14-16		
		Live	Dead		Live	Dead	
Sept 12	DFO	1571	31		200[2]	-	1802
20	DFO	1452	136		221[3]	57	1866

[1] Source: Fee and Sheng (1978).

[2] Observed at Vanderhoof only.

[3] Observed at Braeside and Vanderhoof only.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1979.

Date	Section	Location						Total
		Upper Nechako 1-7		Mid Nechako 8-13		Lower Nechako 14-16		
		Live	Dead	Live	Dead	Live	Dead	
Sept 11-12[1]		387						387
Sept 14[1]								1320
Sept 20[2]		1044	68	125	-	180	50	1467
Sept 20[3]		1526		50		192		1768

[1] Source: Fishery Officer weekly report.
[2] Source: Olmsted, et al. 1980 Appendix V and Figure 8.
[3] Source: Envirocon Ltd. (1980).

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1980

Date		Reach[1] Section	Location: Upper Nechako 1 1-2	Upper Nechako 2 3	Upper Nechako 3 4-7	Mid Nechako 4 8-10	Mid Nechako 5 11-13	Lower Nechako 6 14-16	Total
Sep	2	DFO[2,5]	133	135	93	152	362	23	898
	4	Envirocon[3,6]	6	129	126	12	63	4	340
	5	Alcan[4,7]		610					
	8	Envirocon	68	440	477	93	253	78	1409
	9	DFO	89	298	525	90	216	220	1438
	12	Envirocon	62	584	425	184	289	96	1640
		Alcan		1292					
	16	DFO	232	563	485	52	80	96	1508
		Envirocon	102	299	414	79	183	114	1191
	20	Envirocon	110	584	380	94	138	151	1457
		Alcan		1480					
	23	DFO	105	70	776	8	155	75	1189
	24	Envirocon	256	301	219	33	69	45	923
	29	Envirocon	26	115	59	6	19	8	233
Oct	2	Envirocon	18	57	30	0	1	108	214

[1] Reaches designated by Envirocon Ltd. (Alcan, 1984).

[2] Source: Russell, et al. (1983) Appendix 30.

[3] Source: Alcan (1984) Vol. 5/Section D, Table 3.1.

[4] Source: Farina (1982).

[5] DFO counts by field staff and include migrating, spawning and dead adults, Vanderhoof to Cheslatta Falls.

[6] Envirocon counts include only live spawners on redds, Vanderhoof to Cheslatta Falls.

[7] Counts of live spawners on redds.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1981[1]

Date	Section	Location			Total
		Upper Nechako 1-7	Mid Nechako 8-13	Lower Nechako 14-16	
Sep 17	DFO[2,3]	310	40	50	400 [4]
24	DFO				151 [5]

[1] Source: Fishery Officer Annual Report; Russell et. al. 1983.

[2] Counts by fishery officer(s).

[3] Both counts under turbid water conditions.

[4] No dead in count.

[5] 58 dead in count.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1982

Date	Section	Location						Total
		Upper Nechako 1-7		Mid Nechako 8-13		Lower Nechako 14-16		
		Live	Dead	Live	Dead	Live	Dead	
Sep 14	DFO[1]							950[3]
17	Alcan[2]	830						
20	DFO	500	90	240	81	26	66	1003
25	Alcan	464						

[1] Source: McKee, F. (1982) Prince George Fishery Officer.
Data is also reported in Russell et. al. (1983) but there is an error in the reported Sept. 14 count.

[2] Farina (1983).

[3] Fishery Officer annual report indicates 975 chinook.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1983

Date	Section	Location						Total
		Upper Nechako 1-7		Mid Nechako 8-13		Lower Nechako 14-16		
		Live	Dead	Live	Dead	Live	Dead	
Sep 18	Alcan[1]	250[2]						
19	DFO[3]	208[4]	15	114	13	252	39	641
26	Alcan	111						

[1] Source: Farina, 1984.

[2] From Cheslatta Falls to 32 km below Greer.

[3] Source: McKee, F., Prince George Fishery Officer (pers. comm.); Fishery Officer annual report indicates only 475 chinook.

[4] Distribution in the Upper Nechako was as follows:
Cheslatta Falls to Bert Irvine's - 34 live.
Bert Irvine's to River Ranch - 110 live; 10 dead.
River Ranch to Greer Creek - 64 live; 5 dead.

APPENDIX 10 Nechako River Chinook Spawning Escapement Data, 1984

Date	Observers	Location and/or Reach Number						Total
		Upper Nechako			Mid Nechako		Lower Nechako	
	Reach	1	2	3	4	5	6	
	Section	1-2	3	4-7	8-10	11-13	14-16	
Sep 4	DFO[1]	0	82	28	5	42	151	308
5	Envirocon[2]	7	114	25	3	18	68	235
13	DFO	40	170	135	42	125	775	1287
15	Envirocon	36	176	87	17	90	446	852
24	Envirocon	61	128	55	17	55	175	491

Notes:

[1] Source: Swift, D. (1984) Prince George Fishery Officer.

[2] Source: Mitchell, A.C. (1984) Envirocon Ltd.